

# Mathematical model approach for draft picking in basketball

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## 1 INTRODUCTION

Analytics is being used in all fields such as healthcare, manufacturing, banking and etc. for decision-making. Likewise, analytics is also playing a major role in Sports industry such as football, baseball, basketball and etc. to predict player's next move, injury analysis, position analysis and etc. Sports analytics is being spoken as a concept for many years which could be used to improve team performance, as a result, the revenue generation is very much improved for the team. For this project, we will mostly focus on basketball. In order to have a good prediction and analysis report, we need to have proper dataset and most importantly, the data must also have most important attributes that could provide insights for a given problem.

There are many ways that the data can be used by the team for various purposes. The kind of data that the team would use includes average stats of the players, per game stats, and etc. These data can be used to understand a player in terms of strengths and weaknesses, emotional stability and etc. These attributes could be used to assess the team's performance. Moreover, there are other attributes such as weather conditions, the condition of the field and even psychological factors such as the fans support should be included along with player's data to determine the team's performance. This document speaks about how the data are being used by a basketball team to select players using mathematical models.

## 2 AIM

In this project, the aim is to create a draft picking system for a basketball team by using 3 mathematical models namely, model 1 : model to predict whether a player will stay in the team for five years or not, model 2: model to determine the position of players based on their previous experiences and model 3: model to cluster or group players based on previous performances. These models would facilitate team managers and coaches to select players and make best out of them.

## 3 MOTIVATION

Before the advent of analytics, the selection of players or draft formation was done manually which was a time consuming and huge workload. The emergence of analytics and computing resources has paved a new way in recruiting best players based on their previous performances in a short period of time with minimal workload. However, Sports industry has restricted for the complete adoption of analytics into their respective teams because teams spend three-fourth of their revenue for paying salaries to the players and to cover other expenditures. Hence, the teams cannot afford to invest huge sum of money in technology, data and analytical tools [1]. This project would remove the above mentioned bottleneck and facilitate the teams to use analytical tools with much lower cost and at ease.

## 4 EARLIER SYSTEM

Earlier to 2005, the data was collected by a person watching the game using either a notepad and pen or black boards with chalks. This data was prone to human errors. As a result, the analysis carried out on this data and results were misleading. In 2005, two Israeli scientists, Gal Oz and Miky Tamir, created a system called *SportsVU* (see in figure 1) [4] [11]. This system captures the ball movement as well as athletes movement, all these data are combined together for statistical analysis using the statistical algorithms that the company has created [8]. Based on the statistical analysis inference, the players were chosen for a team, but this method was manual. Moreover, other data such as Rebounds, TurnOver and etc were calculated from this system as well as from manually gathered data.



Figure 1: SportsVU in basketball court.

## 5 BACKGROUND

In this part, some general terms that are relative to the topic are going to be discussed. It is important to understand them for further reading.

The terms that will be discussed are:

- Draft picking and its process.
- Machine learning.
- Sports Analytics.

### 5.1 Draft picking and its process

NBA draft is an annual event where basketball teams select players from american colleges and from international professional league for their rosters. Once a team selects a player, then the team has right to sign a NBA contract with the player.

In draft picking process, teams select eligible players in turns. There are two rounds in the draft where all 30 teams participate to select a player in turns, meaning every year 60 eligible players are drafted, but teams that did not reach the playoffs in the previous regular season or teams with worst performs selects a player by undergoing a process called *NBA Draft Lottery*. This process determines the selection order of the team or provides an opportunity for

the team which wins the lottery to pick the first draft followed by other worst performing teams. The team with best records receives the 30<sup>th</sup> pick. During the second round in the draft, there is no lottery system, but teams pick the draft in the reverse order based on the previous regular season's standings. Moreover, the teams can exchange their draft picks with each other, for example, in 2019 the Minnesota Timberwolves traded the No. 11 pick and forward Dario Saric to the Phoenix Suns in exchange for the No. 6 pick. But, there are some restrictions based on *The Stepien Rule*, that is, this rule prevents the team from trading their first-round draft pick in consecutive years [3].

## 5.2 Machine learning

Machine learning is a general concept and broader area which consists of many definitions provided by recognized and reliable universities, institutions, professors and organizations and they are as follows,

- "Machine learning is based on algorithms that can learn from data without relying on rules-based programming." [7]
- "The field of Machine Learning seeks to answer the question "How can we build computer systems that automatically improve with experience, and what are the fundamental laws that govern all learning processes?" [5]
- and etc.

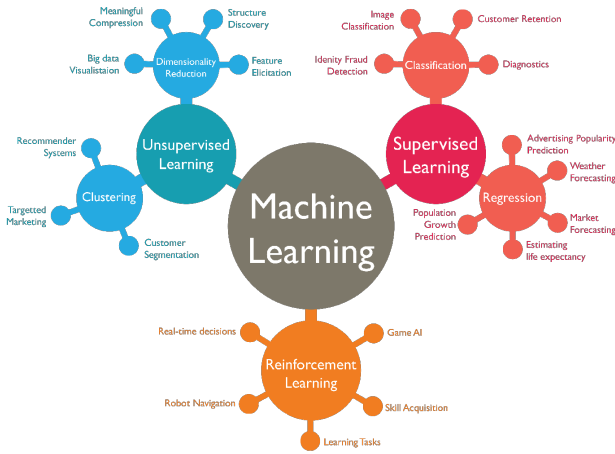


Figure 2: Machine Learning in an eagle view

Machine learning can be categorized in three types,

- Supervised Learning.
- Unsupervised Learning.
- Reinforcement Learning.

The definitions for the above terms are:

- "Supervised learning algorithms generate a function that maps inputs to desired outputs, based on a set of examples with known output (labeled examples)" [10].
- "Unsupervised learning algorithms find patterns and relationships over a given set of inputs (unlabeled examples)" [10].

- "Reinforcement learning, where an algorithm learns a policy of how to act given an observation of the world" [10].

In this project, we will mostly focus on Supervised and Unsupervised learning algorithms. The different types of algorithms in both supervised and unsupervised are given below,

Some algorithms of supervised learning:

- Nearest Neighbor
- Naive Bayes
- Support Vector Machine (SVM)
- Logistic Regression
- Linear Regression
- and etc.

Some algorithms of unsupervised learning:

- k-means clustering
- Association Rules [2]
- and etc.

## 5.3 Sports Analytics

Sports analytics is the application of above mentioned algorithms to sport in order to draw useful insights which could help an individual athlete's performance, or a team's performance for a season. It can also help teams to perform injury analysis and steps to mitigate them, salary of a player based on his previous performances and etc. Nowadays, many teams, coaches and even players are adopting sports analytics for decision making.

"The analytics split nicely between the front-office and back-office. Front-office analytics include topics like analyzing fan behavior, ranging from predictive models for season ticket renewals and regular ticket sales, to scoring tweets by fans regarding the team, athletes, coaches, and owners. This is very similar to traditional customer relationship management. Financial analysis is also a key area, especially for the pros where salary caps or scholarship limits are part of the equation. Back-office uses include analysis of both individual athletes as well as team play. For individual players, there is a focus on recruitment models and scouting analytics, analytics for strength and fitness as well as development, and predictive models for avoiding overtraining and injuries. Concussion research is a hot field. Team analytics include strategies and tactics, competitive assessments, and optimal roster choices under various onfield or on-court situations." [9]

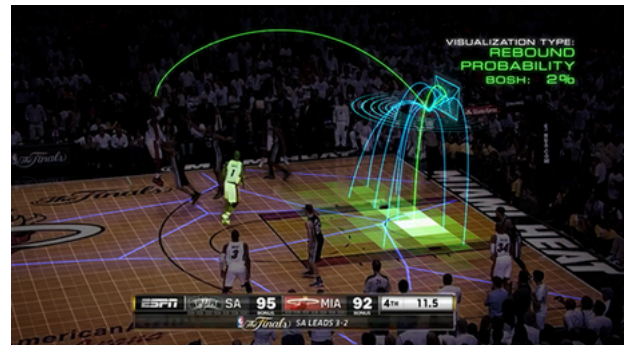


Figure 3: Sports Analytics

However, the analytical methods and data has to be kept safe and should be extremely careful because the data and methodology could lead to numerous problems such as issues with betting companies, non-ethical training of athletes leading to injuries and etc. [6]

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