ICC World Squad Optimization

Abstract— **Cricket madness was at its peak with the recently concluded ICC Cricket World Cup 2023. Apart from the losing and winning teams, the spirit of cricket also has to be celebrated. A great player might also be belonging to the team that did not qualify for the knock-outs. Considering this, a natural quest of creating a team of the best players comes alive. This is the background to our project.**

I. Introduction to the Problem

The aim of the project is to select the best squad of all the players who played the ICC Cricket World Cup, 2023. A squad can be said as a group of fifteen team members such that, there are mandotarily seven batsmen, six bowlers and two wicket-keepers. Wicket Keepers can also bat, which would make total batsmen count to nine. Now, to tell a bowler A is better than bowler B, we consider bowling statistics of the player. Similarly for the batsmen. Also, we assign a price we need to pay to include a player in the squad. The price of the player is directly proportional to the strength of bowling (or batting) as assigned from the statistics of the player. Now, the optimization problem we solve is a multi-objective optimization problem. We need to maximize the overall batting strength (cumulative batting strengths of batsmen) and then the bowling strength (cumulative bowling strength of bowlers) subject to;

1) There are nine bowlers in the squad (including wicket-keepers).
2) There are six bowlers in the squad.
3) There are two wicket keepers (from among the batters).
4) The total price that we need to pay to select the chosen squad is less than a budget constraint B.

II. Assigning Metric to Batsmen and Bowlers

Batting strength and bowler strength or (metric numerically) can be derived from the player statistics. For a batsman statistics such as average, strike rate, number of fifties and number of hundreds are the statistics that have been considered for assigning the metric to batsmen, Now, centuries and fifties are co-related more with the innings that the batsman has played rather than the player strength, Hence, we take into consideration fifties per innings and centuries per innings. Also some statistics such as average and strike rate indicate more of the player strength than centuries per innings and fifties per innings. Hence, the batting strength metric calculated is a weighted average of factors like average, strike rate, hundreds per innings and fifties per innings in that order,

Bowling strength metric of the bowlers include key bowling statistics such as economy, bowling average and bowling strike rate. However being a squad for the limited over format, economy is given higher consideration, then bowling average and then the bowling strike rate,

III. Mathematical Formulation

To start off, we consider sixty players from the four cricketing nations which are;

1) India
2) Australia
3) New Zealand
4) South Africa.

From among these players, we have to pick fifteen players. Also the only **decision** in the problem being selection of the players, the decision variables can be formulated as an array of sixty binary variables. To ensure that only fifteen players are chosen at a time, we add in constraints that the sum of the decision variables equals fifteen.

Also, to determine if a player is a batsman or a bowler from his batting and bowling metric, we normalize the batting and bowling metric (divide by the highest). A player is deemed to be a bowler if;

1) He is not a wicket-keeper.
2) His normalized bowling metric is higher than his normalized batting metric.

With this, we can classify players as batsman/bowler based on boolean variable say b(i). A player is considered to be a batsman is b(i) = 1 and a bowler if b(i) = 0. For the constraint on the number of wicket-keepers, we introduce a set of binary variables w(i) (1 if a player is a wicket-keeper). To enforce the condition of the batsman and bowlers, we add two more constraint;

$$\sum_1^{60} x(i) * (b(i)) = 9`$$
$$\sum_1^{60} x(i) * (1 - b(i)) = 6$$
$$\sum_1^{60} x(i) * w(i) = 2$$

Finally having assigned prices p(i) to each players (depending on their normalized strength), we have the budget constraint;

$$\sum_1^{60} x(i) * p(i) <= B$$

Now, the objective is to maximize the net batting strength metric of the squad, followed by maximizing the net bowling strength metric. Denoting the batting metric with bat(i) and bowling metric with bowl(i), the objective boils down to;

1) Maximize : $\sum_1^{60} x(i) * bat(i)$

2) Maximize : $\sum_1^{60} x(i) * bowl(i)$

Since, limited overs format is more a batsman's game, we give priority to objective-1 and then to objective-2.

IV. Solving the Problem

The objective functions with its constraints being linear, and the decision variables being binary, the problem defined belongs to a popular class of problems called mixed-integer linear problems. There exist popular methods of solving problems that belong to the above class. We use GAMS to solve this problem.

V. Results and Future Scope

Using GAMS, a satisfiable result was obtained for the problem with a minimum budget allocated. A solution was obtained which gave the sum total batting strength (normalized) to be of 12 and the sum total of bowling strength (normalized) to be 7. The list of the players selected is given at end of the report.

Future scopes include including more specifics of the batsmen and bowlers. Which would mean treating opening

batsman and a middle order batsman different, The same can be done for bowlers. Spin and seam bowlers can be can have a different pool out of which they are selected.

The Squad Selected

1) David Miller (Bat)
2) Glenn Maxwell (Bat)
3) Virat Kohli (Bat)
4) Heinrich Klaasen (Bat & WK)
5) Josh Hazlewood (Bowl)
6) Josh Inglis (WK & Bat)
7) Kagiso Rabada (Bowl)
8) Marcus Stoinis (Bat)
9) Mark Chapman (Bat)
10) Mitchell Starc (Bowl)
11) Mohammad Shami (Bowl)
12) Rachin Ravindra (Bat)
13) Reeza Hendricks (Bowl)
14) Sean Abbott (Bowl)
15) Shubman Gill (Bat)

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