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Measuring Efficiency of IPL Players Using EATWOS

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Abstarct : *In this paper, the authors have suggested a new methodology of ranking players using EATWOS (Efficiency Analysis Technique with Output Satisficing) on the basis of the statistics of the Indian Premier League 2013 season. EATWOS combines classical concept of efficiency analysis such as distance measures and efficiency scores with Simon's idea of "satisficing". It integrates the idea of "satisficing" into efficiency by offering the decision maker the opportunity to define a satisficing level for each output.*

In the study, CAA (Consistency Adjusted Average) and BI (Batting Impact) have been identified as outputs and the contractual price of the player as an input. The authors have preferred to use Gini's coefficient over the variance function since it better incorporates consistency into traditional batting average calculations. The BI index has also been modified to suit the T20 format. The results obtained demonstrate a new trend, by which the on-ground dependency of the team over the star players goes down significantly. The study would also help the franchise to choose a winning and satisfactory combination, giving the team a psychological advantage before start of the season.

Keywords : *EATWOS, "Satisficing", CAA, BI, Gini's coefficient*

I. INTRODUCTION

Auction is an essential part in IPL tournament because it offers the franchisees an opportunity to select an appropriate combination of players according to the strategies of the team management. Getting the right combination is very vital since every player has different responsibilities and the focus of the team management should be on assembling a team that theoretically should supplement each other sufficiently so as to put up a winning total on board. However auction does not always follow proper mathematical techniques, but is often overshadowed by factors such as star power, preference to local players, etc. In this paper, the authors have tried to make a point that efficiency of a player with regard to their purchase price should be the guiding factor behind bidding for a player. The result of the study can be used as a guiding factor for the next auctions. Since the purchasing power of all the teams in IPL is more or less homogenous, we can assume that the research methodology discussed in this paper, if taken up by all the teams will lead to a very efficient bidding process.

Traditionally, efficiency is measured by ratio between the output and inputs. In this paper, authors have used EATWOS in measuring the efficiency of players. EATWOS integrates the idea of "satisficing" into efficiency analysis giving the decision maker the opportunity to define a satisficing level for each output. The study has considered the statistics of players in the recently completed IPL 2013 season. The batsmen who come in to bat lower than the fifth position have not been considered because their essential function is to accelerate scoring and as a result of which they exhibit high strike rates and tendency to remain not out which may result in non- uniformity of the sample data. 23 top order and upper middle order batsmen from the various teams who have played over 70% of their team-matches are considered. Since IPL consists of only 16 matches in the League stage, it would render the sample data very thin if the minimum bar of matches is set higher than this.

This paper considers Consistency Adjusted Average (CAA) and Batting Impact (BI) index as outputs. If output quantity of a player exceeds a certain satisficing level, then the player receives the same output score as a player of which the output quantity is equal to the satisficing level. Hence an output quantity meeting a certain satisficing level is judged to be as good as an output quantity exceeding this satisficing level. Equal weights of 0.5 to both the output quantities have been assigned. The authors have also refrained from assigning a satisficing level to the Batting Impact score, since the required data from IPL statistics is not sufficient so as to properly define an appropriate satisficing level for it.

The paper is organised as follows: Section 1 elucidates the formulation of CAA (Consistency Adjusted Average) figures for each player. Section 2 of the paper throws light on BI (Batting Impact) calculations. Section 3 presents the EATWOS model for relative efficiency calculations (with consideration of satisficing levels for the CAA scores) using results from section 1, and 2. The players are then again ranked as per the efficiency values attained from this model.

II. RESEARCH METHODOLOGY

1. Consistency Adjusted Average (CAA) of a player

Traditional average calculation does not provide a completely correct picture of how the batman has performed throughout the season, since the average can be inflated due to few high scores. Hence, CAA has been used to measure the batsman's performance.

$$G = \frac{\sum_{i=1}^{N}\sum_{j=1}^{N}|R_i - R_j|}{2N^2\mu}$$

$$CAA = \mu * (1 - G)$$

where, G is the Gini's coefficient, an indicator of the inequality of the frequency distribution,
R_i *and* R_j are the number of runs scored by the batsman in innings i and j respectively,
μ is the batting average of the player,
N is the number of innings,
CAA is the consistency adjusted average score of the batsman for the entire season.

2. Batting Impact (*BI*) Index of player p in match m

Batting impact (*BI*) score measures a player's performance in the context of a given match. It takes into account not only how many runs a player has scored but also the pace at which he scored the runs and the match conditions under which he scored the runs. A BI score is assigned to every player who batted in a given match based on the following aspects of his performance.

Run Impact (*RI*)
Based on the runs scored by the top 4 batsmen, a base figure is generated for the match. Every performance in the match is thereafter measured against this base figure (as a ratio). One *IMPACT* point is procured when the performance is equal to the base. That is seen as merely the par performance for the top and upper middle order batsmen of the match. This ratio is now called the run impact.

$$RI_{pm} = \frac{runs_{pm}}{base\ runs_m} \qquad \text{(Run Impact)}$$

Strike Rate Impact (*SRI*)
A positive score to the player is assigned if his strike rate is above the mean strike rate for the top order batsmen of the match and a negative score if it is below. If his strike rate equals the mean strike rate of top order batsmen, then his SRI is equal to zero. The SRI for a player p in match m is computed as

$$SRI_{pm} = \frac{strike\ rate_{pm}}{base\ strike\ rate_m} - 1 \qquad \text{(SRI)}$$

The Pressure Impact (*PRI*)
It measures pressure that comes from fall of wickets. It kicks in when a batsman comes in to bat in a tough situation (as defined from how many wickets have fallen) and crosses the base runs. Tough situations are defined as per the base runs. Here *INW* and *INS* denote the number of wickets that had fallen and the score respectively when the concerned batsmen came into bat. *PF* measures the pressure factor which is later used to evaluate the pressure impact per player.

$$PF_{pm} = \frac{\{INW_{pm} * base\ runs_m\} - INS_{pm}}{base\ runs_m} \qquad (Pressure\ Factor)$$

$$PRI_{pm} = PF_{pm} + RIS_{pm} \qquad (Pressure\ Impact)$$

Chasing Impact (*CHI*)
This special score is assigned to a player for staying not out in the second innings of a successful chase. If a player satisfies this criterion, then his *CHI* is equal to his *RI* times 0.8 (as T20 chases are different than ODI chases); otherwise, it is equal to 0.

$$CHI_{pm} = 0.8 * RIS_{pm}\ ,if\ player\ p\ is\ out\ in\ match\ m$$
$$CHI_{pm} = 0\ ,if\ player\ p\ is\ not\ out\ in\ match\ m$$

Batting Impact (*BI*)

$$BI_{pm} = \{RIS_{pm} + SRIS_{pm} + PRIS_{pm} + CHIS_{pm}\}$$

$$(i.e.\ (BI\ score\ for\ player\ p\ in\ match\ m))$$

This gives us the batting impact of each player for each innings that he has played in the concerned season. An average batting impact score using the 16 innings of the IPL6 season is calculated for each player.

Table 1: players with the inputs and outputs

	PLAYERS	SALARY (IN THOUSAND DOLLARS)	CAA	BI
1	A B DE VILLIERS	1100	26.12	21.58
2	MANVENDRA BISLA	54	7.47	22.99
3	RAHUL DRAVID	500	18.16	35.00
4	GAUTUM GAMBHIR	2400	12.84	37.67
5	CHRIS GAYLE	2000	36.50	57.31
6	ADAM GILCHRIST	900	13.07	35.14
7	MAHELA JAYAWARDENE	1400	10.99	38.39
8	DINESH KARTHIK	1200	17.98	29.87
9	VIRAT KOHLI	1800	29.02	42.50
10	MICHAEL HUSSEY	425	32.96	53.76
11	EOIN MORGAN	350	17.88	35.34
12	AJANKYA RAHANE	60	24.38	42.00
13	SURESH RAINA	1300	21.45	26.92
14	ROHIT SHARMA	2000	34.17	38.59
15	VIRENDER	1800	13.18	39.73

	SEHWAG			
16	SACHIN TENDULKAR	1800	10.53	33.46
17	ROBIN UTHAPPA	2100	17.71	41.04
18	MURALI VIJAY	900	12.92	28.54
19	DAVID WARNER	750	18.59	34.16
20	SHANE WATSON	1300	26.34	50.23
21	YUVRAJ SINGH	1800	13.04	13.69

3. Efficiency Analysis With Consideration of Output Satisficing Levels

In the study, CAA (consistency Adjusted Average) and BI (Batting Impact) have been identified as outputs and the contractual price of the player as an input. The authors have preferred Gini's coefficient over the variance function for incorporating consistency into traditional batting average calculations. The Batting Impact (BI) index has also been modified to suit the T20 format.

The authors have refrained from defining any satisficing level for the Batting Impact Index due to unavailability of the sufficient sample data required, in the premature IPL format.

The notations used in the model are as follows:

- l players, l = 1,…..,23
- m Outputs m = 1,2 m=1 for CAA and m=2 for BI
- n Inputs n = 1 n=1 for contractual salary of the player for the concerned 2013 IPL season
- y_{lm} Quantity of output m of player l
- x_{ln} Quantity of input m of player l
- v_m Relative importance weight of output m
- ip_{ln} Distance measure for input n
- op_{lm} Distance measure for output m without consideration of satisficing level
- r_{lm} Normalized quantity of output m of player l
- r_m^* Maximum normalized output quantity
- s_{ln} Normalized quantity of input n of player l
- s_n^* Minimum normalized input quantity
- a_{lm} quantity of output m of player l with consideration of the satisficing level
- SL_m satisficing level for output m

Input and output distance measures' matrix without consideration of satisficing level for Batting Impact (BI) index

$$\exists\, l\ \exists\, m y_{lm} \neq 0 \qquad r_{lm} = \frac{y_{lm}}{\sqrt{\sum_{l=1}^{23} y_{ij}^2}} \forall\, l$$

$$= 1, \dots, 23 \quad for\ m$$

$$= 2\ (the\ batting\ impact\ index)$$

$$\forall\, l = 1, \dots, 23 \quad for\ m = 2 \quad y_{lm} = 0 \ : r_{lm} = 0$$

$$r_m^* = max_l \left\{ \rightarrow_{r_m} \right\} \quad \forall\ m = 2$$

$$op_{lm} = 1 - (r_m^* - r_{lm}) \quad \forall\, l = 1, \dots, 23 \quad \forall\, m = 1,2$$

Similarly,

$$\exists\, l\ \exists\, n x_{ln} \neq 0 \qquad s_{lm} = \frac{x_{lm}}{\sqrt{\sum_{l=1}^{23} x_{lm}^2}} \forall\, l$$

$$= 1, \dots, 23 \quad for\ n$$

$$= 1\ (the\ contractual\ salary\ of\ the\ player)$$

$$\forall\, l = 1, \dots, 23 \qquad \forall\, n = 1 \quad x_{ln} = 0 \ : s_{lm} = 0$$

$$ip_{ln} = 1 - (s_m^* - s_{ln}) \quad \forall\, l = 1, \dots, 23 \quad for\ n = 1$$

This formulates the output distance measures matrix (for the BI index) and input distance measures matrix (for the contractual salary).

Output distance measures matrix with consideration of satisficing level for consistency adjusted average (CAA)

In the study, a satisficing level of28 runs for the Consistency Adjusted Average score has been taken as the CAA scores of most of the batsmenhovered around 23 in the 2013 IPL season.

Using EATWOS,it has been deduced that,

a) If the output quantity takes the value zero,
$$a_{lm} = 0$$
b) If the output quantity takes the value between zero and the satisficing level,
$$0 < y_{lm} < SL_m$$
$$a_{lm} = \frac{y_{lm}}{SL_m}$$
c) If the output quantity is equal to the satisficing level,
$$y_{lm} = SL_m$$
$$a_{lm} = 1$$
d) If the output quantity is greater than the satisficing level,
$$y_{lm} > SL_m$$
$$a_{lm} = 1$$

Now, the new output matrix is normalized by default.

The output distance measures' matrix is then formulated.

$$a_m^* = max_i \left\{ \rightarrow_{a_m} \right\} \quad for\ m$$

$$= 1\ (the\ consistency\ adjusted\ average\ score)$$

$$op_m^{SL} = 1 - (a_m^* - a_{lm}) \quad \forall\, l = 1, \dots, I \quad for\ m = 1$$

Table 2: The efficiency scores and ranking

RANK	PLAYERS	EFFICIENCY SCORES
1	MICHAEL HUSSEY	0.935776497
2	AJINKYA RAHANE	0.888940786
3	SHANE WATSON	0.795987104
4	CHRIS GAYLE	0.768776178
5	VIRAT KOHLI	0.752750613
6	A B DE VILLIERS	0.740306632
7	ROHIT SHARMA	0.725907445
8	EOIN MORGAN	0.720858748
9	RAHUL DRAVID	0.70897632
10	DAVID WARNER	0.688917078
11	SURESH RAINA	0.664548028
12	DINESH KARTHIK	0.628084558
13	ADAM GILCHRIST	0.590174957
14	ROBIN UTHAPPA	0.583336867
15	MURALI VIJAY	0.57043947
16	VIRENDER SEHWAG	0.537847766
17	MANVENDRA BISLA	0.531129938
18	MAHELA JAYAWARDENE	0.529705621
19	GAUTAM GAMBHIR	0.492309405
20	SACHIN TENDULKAR	0.485887512
21	YUVRAJ SINGH	0.474795542

III. CONCLUSIONS

The results obtained demonstrate a new trend, by which the on-ground dependency of the team over the star players goes down significantly. The study shows how incorporating EATWOS, into efficiency analysis for IPL 2013 players, offers a more comprehensive and better ranking of the players. It would also help the franchise to choose a winning and satisfactory combination, giving the team a psychological advantage before start of the season. It would hence rationalize the bidding process for the players.

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