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Abstract

A balanced squad in cricket contains players with different expertise like batting, bowling, all-rounder and wicket keeping. Maintaining these cricketing requirements, selecting an optimal squad is a difficult decision making problem. The selectors have chosen cricketers using their own experience and based on the recent performances of available players from all the different expertise. The paper introduces a measure that can quantify the performance of the cricketers into a single numerical value, which is a measure of the player's cricketing efficiency. The distributional pattern of the performance measure is identified and then used to recognize the performers under different expertise. The entire exercise simplifies the job of the selectors as they now have a smaller subset to choose from. To explain the model empirically, data of the Indian Premier League (IPL), 2012 is used to identify the performers of the game under different expertise. The actual Indian team selected just after the said season of IPL is then compared with the performers of IPL, 2012 as identified by the model. It was found that several non-performers were selected in the actual squad and some performers were left out. This model can be extended for the team selection in other versions of cricket and even in other team sports.

Keywords: Composite Index, Cricket, Probability Distribution, Performance Measurement, Sports

1. Introduction

Cricket is an outdoor game played with bat and ball in a specially prepared area in the center of circular field called a pitch. The game is played under certain rules and regulations between two teams of eleven players each. The teams take turn at batting and fielding. Each of such turn is called an innings. The aim of the fielding team is to dismiss all the batsmen of the batting team and /or to restrict the flow of runs. Presently, there are three versions of cricket being played at the international level: test cricket, one-day international cricket and Twenty20 cricket. The international governing body of cricket popularly known as International Cricket Council (ICC) is responsible for the organization and governance of major international cricket tournaments. Now the ICC has 104 member countries and out of which 10 are full members that play official test matches, 34 associate members and 60 affiliate members. Along with the 10 full member countries, the 34 associate member countries are awarded both one-day international and Twenty20 status by the ICC.

Irrespective of the type of membership of the country or the format of cricket, the process of national team selection is almost similar. Each cricket board appoints a committee of selectors generally comprising of veteran cricketers. The selectors use their experience and expertise to select the team based on recent performance of the available cricketers. A cricket team requires the service of cricketers having different expertise like specialist batsmen, spin bowler, fast bowler, all-rounder and wicket keeper. The responsibility of the selectors is not only to choose the best players but a balanced team with in-form players from all the different expertise. The number of cricketers selected under different expertise shall be in the proportion in which their services are required in the team.

The selectors, sufficiently before a cricket series, declare a set of cricketers for the national team. However, various factors are involved in selecting a balanced national cricket team, for example - pitch condition, whether the tournament is played in home / away ground etc. Sometimes selectors may want to give chance to an experienced senior player who is out of form (Lemmer, 2011).The selection is done from a host of available players, who according to the opinion of the selectors are the best players under the different expertise. While selecting the cricketers the recent form of the players, their ability to adapt with the playing conditions in the upcoming series, experience, etc. are generally considered. In the absence of any appropriate methodology, the process of selection remains a subjective method. Thus, the competence of the selectors is often challenged by fans and cricket officials, especially if the team fails poorly in the series for which the team is selected.

Cricket is a game which generates a huge amount of numerical information. It is often called as the game of statisticians delight. This is probably the only game which has official statisticians associated with it. It is no surprise that often application of statistical tools and models are used for decision making in cricket. A brief discussion on such issues shall be covered in literature review section. The current research introduces a statistical model which would provide the selectors an objective way of selecting a cricket team. In the backdrop of the previous discussion, the model introduced in this paper shall be of practical use to the selectors. The model is designed to identify the performers under different expertise based on their recent acts in the cricket field. The selectors now can use their judgment of choosing the team from amongst the performers only, under the different expertise, which is a much smaller subset compared to the host of available cricketers.

2. Review of Literature

There are several numerical aspects of cricket that were addressed by the researchers at several occasions. The current review of literature covers only those works that are related to the theme of the paper namely, mathematical/statistical models for team selection. The process of team selection is based on a two way methodology. First, a measure to quantify the performance of cricketers and the second part comprises an optimized method for team selection.

The optimal player selection for a cricket team can not be fair unless the best available performance measures are used (Lemmer, 2011). Several performance measures have already been developed by different authors in this regard. Lemmer (2002) devised a measure known as combined bowling rate (CBR) to measure the performance of bowlers by combining the three traditional bowling statistics *viz.* bowling average, economy rate and bowling strike rate through harmonic mean. A comprehensive measure of batting performance (BP) to assess the performance of batsmen in limited over cricket was also developed by Lemmer (2004). The batting performance measure (BP) was a product of exponentially weighted batting average, standardized coefficient of consistency and standardized strike rate of the batsmen. Barr and Kantor (2004) proposed an alternative batting performance measure for comparing and selecting batsmen in limited over cricket. This measure is a weighted product of batting average and strike rate of the batsmen. Various indices are developed by Gerber and Sharp (2006) to measure the performance of batsmen, bowlers, all-rounders, wicket keepers, etc. A performance measure for wicket keepers is developed by Lemmer (2011), combining the dismissal rate and a measure of batting performance. Of late, a new measure called Pressure Index is developed by Shah and Shah (2014) under which the actual performance of the batsmen can be measured. They believes that runs scored under pressure are more valuable than runs scored under not as much of pressure. In view of that factors such as runs scored, runs left, number of wickets, balls faced and balls left are considered for developing the measure. An alternative measure of player performance is developed by Lewis (2005) that can be used to measure the performancebased on ball-by-ball information of a match. However, collecting ball-by-ball information from a match or a series of matches is tedious. Therefore, it would be better if scorecard of the match could be utilize to quantify the on-field performance of the players. A match scorecard only provides the information of traditional performance statistics like batting average, strike rate, economy rate, etc. However, such statistics have severe limitations in assessing the true abilities of a players' performance (Lewis, 2005) because the different traditional performance statistics are in different units of measurement. Therefore, to assess a player's all-around performance, this paper attempts to develop a fairer performance measure by combining the different factors under skills of the game *viz.* batting, bowling etc. This can be used to measure the performances of batsman, bowler, all-rounder and wicket keeper based on the scorecards of matches, which is relatively easier.

On the other hand, most authors who addressed the issue of team selection, on quantifying the performance of cricketers, used different optimization tools for such selection. Kamble *et al.* (2011) presented a selection procedure using analytical hierarchical process to choose a subset of players from a universal set of cricketers comprising of batsmen, bowlers, all-rounders and wicket keepers. Two other works addressing the same issues are Lemmer (2011) and Ahmed *et al.* (2011). While Lemmer (2011) used integer programming to reach the solution, Ahmed *et al.* (2011) used evolutationary multi-objective optimization to choose the cricket team. Barr and Kantor (2004) used portfolio analysis to determine the set of batsmen who are supposed to be more suitable for a one-day squad. Gerber and Sharp (2006) proposed an integer programming technique in order to select a limited over squad of 15 players instead of a playing XI. The method included collecting the data from 32 prominent South African cricketers to select the ODI squad. Extending the same idea, Lourens (2009) selected an optimal Twenty20 South African cricket side based on performance statistics of a host of players who participated in the SA domestic Pro20 cricket tournament. Using an integer programming, Brettenny (2010) selected players for a fantasy league cricket team under certain pre-specified bugetary constraints, but with a progressive approach. This optimal team at each stage of the tournament, considered the performance of available cricketers upto the previous match. Though most authors used the binary integer programming tool for the purpose of the optimized team selection, yet they used different tools for measuring the performance of cricketers. Some authors used the traditional statistics like batting average, strike rate, etc. for quantifying performance of cricketers, while others tried to combine such traditional measures to a refined statistic to evaluate players' performance. Authors like Lourens (2009) and Brettenny (2010) combined/compared different refined measures forwarded by others in the process of optimal team selection. An objective approach of a balanced cricket team selection is proposed by Bhattacharjee and Saikia (2015) using binary integer programming method through combining traditional performance statistics in eloquent way.

However, these selection methods discussed earlier were too objective. They did not have any relaxation for subjective matters like playing condition of the up-coming series, giving another chance to senior cricketers etc., which are an integral part of team selection. The metodology of the previous studies lead to very stringent results of reaching to the optimal squad based on the previous performance of the cricketers only. Most such models are unable to quantify several subjetive matters that selectors need to consider. Considering this is mind the current model identifies the distributional pattern of the performance measure of cricketers under different expertise and elicit the performers of the game. This is a subset of the universal set of available cricketers for selection. The method provides the selectors a smaller number of players to choose from. The model can be claimed to make the job of the selectors easier and has space for the subjectivity necessary for team selection.

3. Methodology

The methodology used for performing the task can be broadly classified into two sections. The first section introduces the performance measure that shall be used to quantify the feat of the cricketers based on the matches of the recent past (Subsection 3.1). The second section deals with the identification of the distributional pattern of the performance index of the cricketers under different expertise and to identify the performers under those expertise (Subsection 3.5).

3.1. Performance Measure

In cricket, different measures like batting average and strike rate that are mostly used to measure the performances of batsmen and bowling average, economy rate and bowling strike rate to measure the performance of bowlers. However, Lewis (2005) mentioned that the traditional measures of performances do not allow combining of the abilities of batting and bowling, as they are based on incompatible scales. To overcome the above limitation the following performance measure is proposed.

The performance measure of the i^{th} player is given by,

$$S_i = S_{i1} + S_{i2} + \delta_i \qquad \ldots (1)$$

where $\delta_i = \begin{cases} S_{i3}^{a_i} + S_{i4}^{1-a_i} - 1, & \text{if } i^{th} \text{ player is either a bowler or wicket keeper} \\ 0, & \text{if } i^{th} \text{ player is neither a bowler nor wicket keeeper} \end{cases}$

where 'a_i' is an indicator variable with,

$$a_i = \begin{cases} 1, & \text{if } i^{th} \text{ player is a bowler} \\ 0, & \text{if } i^{th} \text{ player is a wicket keeper} \end{cases}$$

with, S_{i1} = Performance score for batting
S_{i2} = Performance score for fielding
S_{i3}= Performance score for bowling
S_{i4} = Performance score for wicket keeping

To measure the batting performance of a cricketer (S_{i1}) the factors considered are batting average, batting strike rate and average percentage contribution to the team total, number of 30+ scores, balls faced by the batsman per boundary, percentage of dot balls and percentage of runs scored in boundaries (*cf.* Saikia *et al.*, 2013). The values of these factors for each player are normalized and then weights of these factors are calculated based on their relative importance. All the normalized scores for the considered factors are multiplied by their corresponding weights and then added together to get S_{i1}.

The different factors that are considered to quantify the fielding performance of a cricketer (S_{i2}) are number of catches taken by the player, number of direct hit run out caused by the player, number of runs saved, number of runs missed due to bad fielding, number of chances run out missed and number of good throws. The values of these factors for each player are normalized and then weights of the factors are calculated based on their relative importance. All the normalized scores for these two factors are multiplied by their corresponding weights and then added together to get S_{i2}.

The different factors that are considered while computing the performance score of bowler (S_{i3}) are bowling average, economy rate and bowling strike rate, number of balls conceded per boundary, percentage of dot balls and percentage of runs conceded. The values of these factors for each player are normalized and then weights of these factors are calculated based on their relative importance. As earlier, all the normalized scores for the considered factors are multiplied by their corresponding weights and then added together to get S_{i3}.

To measure the performance of a wicket keeper (S_{i4}) the different factors considered are number of runs saved, runs missed, catches taken per match, number of stumping per match, number of direct hit run out and number of bye runs conceded per match. Here the phrase 'per match' means the number of matches when the player kept the wickets for his team. This is because some of the teams have more than one player in their playing eleven who are capable of wicket keeping. Similarly, the values of these factors for each of the player are normalized and then weights of these factors are calculated. Finally, all the normalized scores for the considered factors are multiplied by their corresponding weights and then added together to get S_{i4}.

3.2. Normalization

The developed performance measure is a linear combination of traditional performance statistics under the abilities of batting, fielding, bowling and wicket keeping. Therefore, to overcome this limitation of different measures having different units the use of normalization is essential. Normalization aids to eliminate the unit of measurement and variability effect of all the traditional performance measures. Based on normalization, the traditional performance measures under the abilities of batting, bowling and wicket keeping come within a similar range from 0 to 1. Since normalization makes the measures unit free, so they can be combined through addition. Out of the different factors considered for performance measurement, some are having positive dimension like batting average, batting strike rate, number of stumping, etc. as they are directly related to the ability of a player. While some of the factors like economy rate, number of bye runs conceded, etc. have reverse dimension as they are negatively related to the ability of a player. Therefore, proper care shall be taken in the formula while normalizing such variables.

Let X_{ijk} be the value of the j^{th} factor (*i.e.* batting average, strike rate, etc.) for the i^{th} player in the k^{th} ability (*i.e.* batting, fielding, bowling and wicket keeping). Now, if the factor is positively associated with the ability of a player then it is normalized as

$$Y_{ijk} = \frac{X_{ijk} - \min(X_{ijk})}{\max(X_{ijk}) - \min(X_{ijk})} \qquad \ldots (2)$$

and if the factor is negatively associated with the ability of a player then it is normalized as

$$Y_{ijk} = \frac{\max(X_{ijk}) - X_{ijk}}{\max(X_{ijk}) - \min(X_{ijk})} \qquad \ldots (3)$$

The maximization or minimization is done over all i keeping the values of j and k fixed.

3.3. Determination of Weights

The next step would be to determine the weights for different factors under the abilities of batting, fielding, bowling and wicket keeping. While simple averages provide equal importance to all the variables, a composite measure is weighted and relative importance of the variables can be considered. Iyenger and Sudarshan (1982) assumed that the weights vary inversely proportional to the variation in the respective variables. This method is applied to determine the weights of the different factors.

Let Y_{ijk} be the normalized value of the i^{th} player for the j^{th} factor of the k^{th} ability. Now, if w_{jk} represents the weight of the j^{th} factor under the k^{th} ability, then it is calculated as

$$w_{jk} = \frac{C_k}{\sqrt{\underset{i}{Var}(Y_{ijk})}}, \qquad j = 1, 2, 3, 4, 5, 6 \qquad \text{and } k = 2, 3, 4 \qquad \dots (4)$$

where, $\sum_{j=1}^{6} w_{jk} = 1$ for $k = 2, 3, 4$

C_k is a normalizing constant that follows $\quad C_k = \left[\sum_{j=1}^{6} \frac{1}{\sqrt{\underset{i}{Var}(Y_{ijk})}} \right]^{-1}$

Since seven (7) different factors are considered under batting ability *viz.* batting average, batting strike rate, etc. therefore, if w_{jk} represent the weight of the j^{th} factor under the batting ability ($k = 1$) then it is calculated as

$$w_{jk} = \frac{C_k}{\sqrt{\underset{i}{Var}(Y_{ijk})}}, \qquad j = 1, 2, 3, 4, 5, 6, 7 \qquad \text{and } k = 1 \qquad \dots (5)$$

where, $\sum_{j=1}^{7} w_{jk} = 1$ for $k = 1$

C_k is a normalizing constant that follows $\quad C_k = \left[\sum_{j=1}^{7} \frac{1}{\sqrt{\underset{i}{Var}(Y_{ijk})}} \right]^{-1}$

The weights as discussed in Iyenger and Sudarshan (1982) act as variance stabilizer to the normalized variables and restrict the dominance of any of the variables in the composite index. The different factors along with its respective weights are given in the Table 1.

Table 1. Weights of the factors in different abilities

	Factors	Weights		Factors	Weights
Batting	Batting average	0.12701	Bowling	Bowling average	0.20367
	Strike rate	0.15218		Economy rate	0.20647
	Average percentage of contribution to the	0.13246		Bowling strike rate	0.15832
	30+ scores	0.13375		Dot ball percentage	0.15166
	Batting balls per boundary	0.15298		Balls conceded per boundary	0.13856
	Dot ball	0.14609		Percentage of runs conceded in boundaries	0.14129
	Percentage of runs scored in	0.15549			
Fielding	Runs saved	0.16642	Wicket Keeping	Runs saved	0.19412
	Runs missed	0.16026		Runs missed	0.17303
	Catches taken	0.17115		Catches taken per	0.14323
	Direct hit run-out	0.16315		Direct hit run out	0.13371
	Run-out missed	0.17258		Stampings	0.17434
	Good throws	0.16641		Bye runs conceded	0.18154

3.4. Computation of Performance Score

The normalized factors are then multiplied by weights and combined in a linear fashion to get the composite index. This index is the performance measure of each cricketer (*i.e.* S_i). The performance scores of S_{i1}, S_{i2}, S_{i3} and S_{i4} for batting, fielding, bowling and wicket keeping are computed as follows.

The performance scores for batting (k = 1), fielding (k = 2), bowling (k = 3) and wicket keeping (k = 4) of the i^{th} player is calculated by

$$S_{ik} = \sum_{j=1}^{n_k} w_{jk} Y_{ijk} \; ; \qquad \text{where } n_k = 6 \text{ for } k = 2, 3 \text{ and } 4 \text{ and } n_1 = 7 \qquad \dots (6)$$

Now, on obtaining the values of S_{i1}, S_{i2}, S_{i3} and S_{i4} the performance score S_i of the i^{th} player is computed using equation (1). The performance score of all the players are computed and then converted into corresponding performance index (P_i). The performance index of the i^{th} player is denoted by P_i and is given by,

$$P_i = \frac{S_i}{\max_i (S_i)} \qquad \dots (7)$$

The performance index for each player is a number lying between zero and one (*i.e.* $0 < P_i \leq 1$). Higher the value of the performance index better is the performance of a player.

An inverted flowchart is also provided in Figure 1 to understand the performance measure developed in this paper.

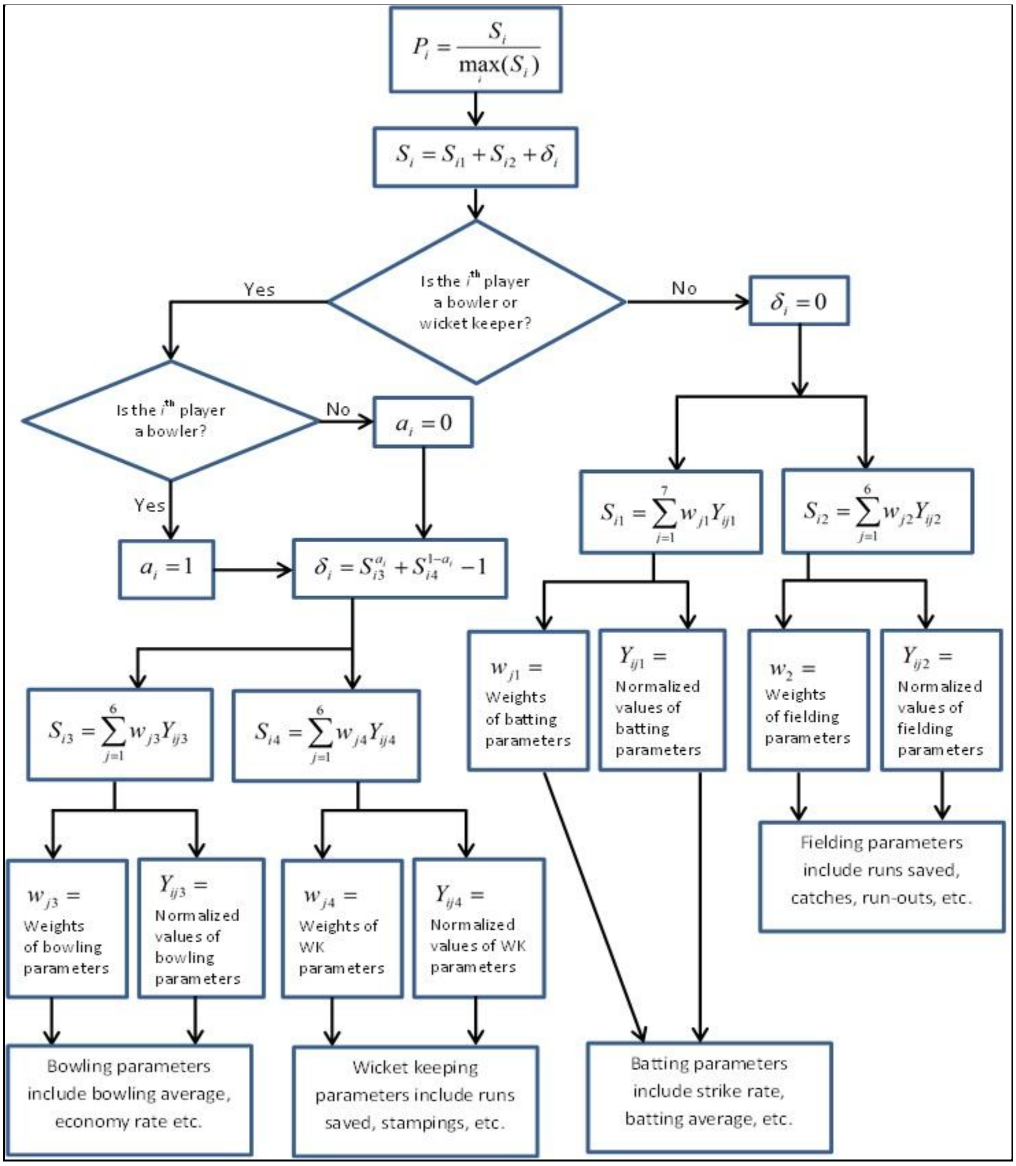

Figure 1. Inverted flowchart for computing the performance index

3.5. Identification of the performers under different expertise

The first step towards identification of the performers under different expertise is to recognize a probability distribution of the performance index. As the value of the performance index, $P_i \in [0, 1]$ so the values are essentially continuous in nature. The Anderson-Darling test can be used to check whether performance index values are drawn from a given probability distribution. This test is popularly known as distribution free test because it assumes that there are no parameters to be estimated in distribution being tested. It is the most powerful statistical test for examining specific distribution of a given sample of data. Under the null hypothesis the data follows a specific distribution, the Anderson-Darling test statistics is defined as –

$A^2 = -N - S$ … (8)

where $S = \sum_{i=1}^{N} \frac{(2i-1)}{N} [\ln F(Y_i) + \ln(1 - F(Y_{N+1-i}))]$, F is the cumulative distribution function of the specified distribution and Y_i are the ordered data.

After deciding about the probability distribution of P_i it is important to find two real numbers c, $d \in [0, 1]$ to divide the performance index into three linear intervals namely $[0, c]$, $[c, d]$ and $[d,1]$with the same probability weight of 33.33%, i.e.,

P $[0 \le P_i \le c] = 0.3333$ … (9)

and, P$[0 \le P_i \le d] = 0.6666$ … (10)

Thus, P$[c \le P_i \le d] = 0.3333$ using (9) and (10)

These intervals are used to characterize the various levels of performances of the cricketers as follows:

(i) Poor Performers if $0 \le P_i \le c$

(ii) Average Performers if $c \le P_i \le d$

(iii) Performers if $d \le P_i \le 1$

3.6. Data Consideration

The data related to the performance of the Indian players in IPL 2012 is considered as the basis of selection of the players for the optimum team. The information is collected from the website *www.cricket-21.com*. To measure the performance of players it is necessary that players' statistics for large number of games should be considered. The expectations regarding level of performance cannot be gauged fairly from only one match and therefore individual performances across a series of matches are required to provide a suitable frame of reference (Bracewell and Ruggiero, 2009). Thus, some selection criterion needs to be set up while considering the players for performance measurement. Only Indian players are selected based on the following criteria from the fifth season of IPL.

For batsmen:
a) Played atleast five innings in the fifth season of IPL
b) Faced atleast 60 balls in the fifth season of IPL
c) Batting average greater than or equal to 10 in the season

For bowlers:
a) Played atleast five matches in the fifth season of IPL
b) Delivered atleast 60 balls in the fifth season of IPL
c) Dismissed atleast 3 batsmen in the fifth season of IPL

For wicket keepers:
a) Played atleast five matches as wicket keeper in the fifth season of IPL
b) Dismissed atleast 3 batsmen in the fifth season of IPL
c) Satisfied all three conditions for batsmen selection

For all-rounders, the conditions for both the batsmen and bowlers should be satisfied. 68 Indian players from IPL 2012 satisfied the above-mentioned criteria. The list includes

22 batsmen, 20 fast bowlers, 11 spinners, 8 all-rounders and 7 wicket keepers. Several different factors are considered on the basis of role of the cricketers in the team *viz.* batsman, bowler, etc. and then aggregated to calculate the performance of the selected Indian cricketers. Correlation analysis is performed among the factors under different skills of the cricketers. Based on the analysis, for example there is a strong positive correlation between the 'Run-out Missed' and 'Bad Throws' (*i.e.* $r > 0.87$, $p < 0.05$), thus the factor 'Run-out Missed' is considered and 'Bad Throw' is removed from further analysis. The final list of the factors under different skills (*viz.* batting, bowling, fielding and wicket keeping) used in the study is already mentioned in the subsection 3.1.

4. Analysis and Results

Since the performance index of the cricketers are positive (*i.e.* $P_i > 0$) and continuous in nature, therefore the probable distribution is normal distribution. The distribution is given by the density function

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left[\frac{x-\mu}{\sigma}\right]^2} \quad \text{where } -\infty < x < \infty \qquad \ldots (11)$$

where μ and σ are the mean and standard deviation of the normal distribution, which are estimated from the data. However, it has been observed that instead of P_i values, the transformed values of P_i [*i.e.* $\log(P_i)$] are better fitted to normal distribution. Therefore, $\log(P_i)$ values are used to fit normal distribution as well as to determine the level of performance of the cricketers. The following Anderson–Darling test result where *p*-value is 0.221 which is greater than 0.05 and also normal probability plot confirms that the $\log(P_i)$ values follow normal distribution.

Table 2. Result of Anderson-Darling Test

Anderson-Darling	
A^2	0.484
One-tailed p-value	0.221
Alpha (α)	0.05

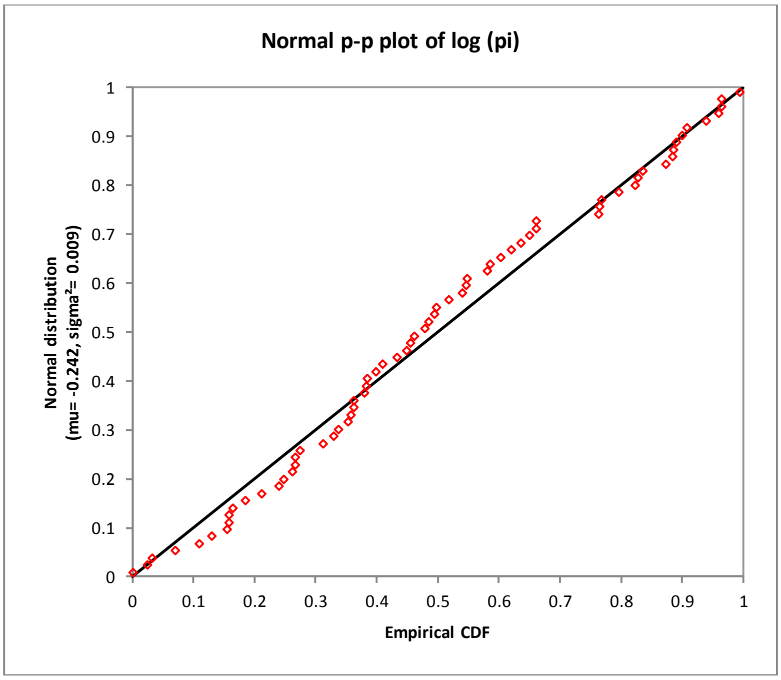

Figure 2. Normal p-p plot of transformed performance index values (log(P_i))

Now the two real numbers *c* and *d* (as mentioned earlier) that are obtained from the normal distribution based on log(P_i) values to identify the level of performance of the cricketers can be seen in Table 3.

Table 3. Interval for identifying the level of performance of the cricketers

Category	Intervals
Poor Performer	Greater than - 0.28495
Average Performer	Less than - 0.2849 to Greater than - 0.20208
Performer	Less than – 0.20208

(Note: Since log(P_i) values are used to identify the performers thus lower the value of log(P_i) better is the player in terms of performance)

Now based on these intervals (*cf*. Table 3), the cricketers those who have high level of performance (termed as performers) are identified. Such players can only be considered by the selectors for including in the squad under different expertise. After the end of IPL 2012, the next international Twenty20 outing of India was against Sri Lanka on August 7, 2012 at Pallekele, Sri Lanka. It is expected that a better squad shall be one which includes the performers of IPL 2012, under different expertise. Table 4, shows the performance level of the cricketers who were actually included in the squad and the performers under different expertise who were denied a place in the national team.

Table 4. Performers of IPL 2012 and the actual Indian Twenty20 team selected following the IPL

Cricketers	Performer	Member of Indian Team	Comment on the selection process of the Indian team
Batsmen			
AM Rahane	Yes	Yes	
G Gambhir	Yes	Yes	
RG Sharma	Yes	Yes	
S Dhawan	Yes	No	Rejected a performer
V Sehwag	Yes	Yes	
V Kohli	No	Yes	Included of a non-performer
M Tiwari	No	Yes	Included of a non-performer
Spinners			
P Negi	Yes	Yes	
R Ashwin	Yes	Yes	
P Ojha	No	Yes	Included of a non-performer
R Sharma	No	Yes	Included of a non-performer
Fast Bowlers			
AB Dindha	No	Yes	Included of a non-performer
R Bhatia	Yes	No	Rejected a performer
Z Khan	Yes	Yes	
U Yadav	Yes	Yes	
Wicket Keepers			
MS Dhoni	Yes	Yes	
RV Uthappa	Yes	No	The position was already filled
All-rounders			
IK Pathan	Yes	Yes	
SK Raina	Yes	Yes	
RA Jadeja	Yes	No	Six batsmen were considered in the team. So only two slot of all-rounders were filled by IK Pathan and SK Raina none others can be considered
STR Binny	Yes	No	

Thus, from Table 4, one can find that out of 16 players in the Indian squad selected following the IPL 2012, there were five players who were not 'performers' in their expertise as per the model. Some players like all-rounders RA Jadeja and STR Binny and wicket keeper RV Utthapa were ignored because of lack of place in the team considering their expertise. However, performers like S Dhawan and R Bhatia were ignored and replaced in the said Indian national team by some players who had a poor or average level of performance in IPL 2012. Thus, the model does not recommend the assortment made by the Indian selectors for the Twenty20 match against Sri Lanka at Pallekele.

6. Conclusion and Future Scope of the Study

Selecting the optimal squad keeping in view the cricketing requirements, from the available players having different abilities is a difficult task. Along with subjectivity, many other factors are involved in the selection of a cricket team (Lemmer, 2011). For example - inclusion of a player in the optimal squad of a team is dependent on the strength of the opponent, pitch condition, format of the game, experience of the players, etc. The difficulty of such subjective state of affairs can be traded by using some objective method like the one, applied in this paper. However, the selection of the players using any such mathematical/statistical methods is largely dependent on the tool used for quantifying the performance of the players. If the performance measurement tools are changed, then the 'performers' as per the model may suffer minor changes.

The model has a two way use. If the model is applied before team selection then the findings would provide guidelines to the selectors for deciding the optimal squad of a given team. If the model is used after the team selection then the fans and officials of the game can identify the cricketers who were ignored by the selectors even after their valiant performance in recent past. In other words, it can also identify those players who do not deserve, but were offered an entry to the national squad by the selectors. Thus, the model can also be used to monitor the efficiency of the selectors. Finally, it may be concluded in support of the statement given by Lemmer (2011) that, "… to select an optimal squad before any given tournament, close co-operation between the selectors and the cricket statisticians are needed."

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Appendix – A

Batsmen	log(P_i)	Performance Level
AM Rahane	-0.16151	Good
AT Rayudu	-0.26459	Average
DB Das	-0.30057	Poor
G Gambhir	-0.12258	Good
M Manhas	-0.27646	Average
M Vijay	-0.28328	Average
MA Agarwal	-0.2851	Poor
Mandeep Singh	-0.24277	Average
MK Pandey	-0.35178	Poor
MK Tiwary	-0.27137	Average
R Dravid	-0.25324	Average
RG Sharma	-0.12579	Good
S Badrinath	-0.34081	Poor
S Dhawan	-0.13135	Good
SP Goswami	-0.57992	Poor
SR Tendulkar	-0.30859	Poor
SS Tiwary	-0.4223	Poor
V Kohli	-0.20198	Good
V Sehwag	-0.17094	Good
Y Nagar	-0.33722	Poor
Y VenugopalRao	-0.38602	Poor

Bowlers	Category	log(P_i)	Performance Level
A Mishra	Spin	-0.24346	Average
AA Chavan	Spin	-0.25152	Average
Ankit Sharma	Spin	-0.30445	Poor
Iqbal Abdulla	Spin	-0.21238	Average
M Kartik	Spin	-0.27881	Average
P Negi	Spin	-0.17244	Good
PP Ojha	Spin	-0.24763	Average
KP Appanna	Spin	-0.21684	Average
R Sharma	Spin	-0.28989	Poor
R Ashwin	Spin	-0.15209	Good
SB Jakati	Spin	-0.27195	Average
A Ashish Reddy	Fast	-0.23769	Average
A Nehra	Fast	-0.27655	Average
A Singh	Fast	-0.36196	Poor
AB Dinda	Fast	-0.25466	Average
B Kumar	Fast	-0.26719	Average
Harmeet Singh	Fast	-0.23045	Average
HV Patel	Fast	-0.20831	Average
L Balaji	Fast	-0.25856	Average
MM Patel	Fast	-0.27076	Average
MS Gony	Fast	-0.31083	Poor
P Awana	Fast	-0.22231	Average
P Kumar	Fast	-0.27784	Average
Pankaj Singh	Fast	-0.32033	Poor
R Bhatia	Fast	-0.202	Good
RP Singh	Fast	-0.24587	Average
SK Trivedi	Fast	-0.23261	Average
UT Yadav	Fast	-0.17205	Good
V Pratap Singh	Fast	-0.33961	Poor
VR Aaron	Fast	-0.22139	Average
Z Khan	Fast	-0.20199	Good

All-rounders	log(P_i)	Performance Level
SC Ganguly	-0.31776	Poor
SK Raina	0	Good
Harbhajan	-0.22559	Average
IK Pathan	-0.06668	Good
PP Chawla	-0.21355	Average
R Vinay	-0.28742	Poor
RA Jadeja	-0.07203	Good
STR Binny	-0.06771	Good
YK Pathan	-0.20918	Average

Wicket Keepers	log(P_i)	Performance Level
MS Dhoni	-0.15046	Good
NV Ojha	-0.20478	Average
MS Bisla	-0.30294	Poor
KD Karthik	-0.32967	Poor
PA Patel	-0.33961	Poor
RV Uthappa	-0.20197	Good
N Saini	-0.43389	Poor