Probability of Success of a Batsman for Scoring at Least Fifty Runs in any One-Day International Cricket Match

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ABSTRACT

This paper develops a method for assessing the probability of consistent batting performance of the batsmen in the ODI cricket by using the Competency Levels of the batsmen. The Competency Levels of seven contemporary batsmen of Team India are computed on the basis of the ratings of 52 cricket fans on the skill and attitude components of the batsmen. Thereby the Probability of Success of each batsman for scoring at least fifty runs in any ODI match is computed against the numerical value of his Competency Level. The Rate of Success of the batsmen for scoring at least fifty runs per 'effective opportunity' in ODI cricket matches is calculated from statistical data of past performances of the batsmen. There is a strong positive linear relationship between the Probability of Success and the Rate of Success having Correlation Coefficient r=0.8709. This paper has a capacity to encourage the selectors of cricket teams for using the concept of the Probability of Success instead of the statistical records of performances in selecting batsmen for their teams.

Keywords: batsman, batting consistency, cricket, competency level, probability of success

The game of cricket was begun to be played in rural southern England in the sixteenth century. It travelled with the British Empire, being played by the soldiers and the officers in reaches of the empire ranged from Australia to Caribbean. Now it has become a mass sport with a global following (Mustafa, 2013). In the pre One-Day International (ODI) era, the batting average i.e. the average runs scored before getting out was the primary indicator of the batting performance of any batsman. The ODI matches have been introduced in the international cricket to reduce the number of draw matches and to increase excitement in cricket through more aggressive batting (Swartz *et al.,* 2006). With the advent of growing importance of the ODI or limited over cricket, the strike rate, runs scored per ball faced has also become the key indicator along with the average score of batting for statistical analysis of batting performance of any batsman

(Barr and Kantor, 2004). The researchers have also tried to find out the consistency of batting performance (Barr and van den Honert, 1998) but all the approaches are based on statistical records of past performances.

In spite of the existence of strike rate and batting average concept, selectors of the ODI cricket teams are often confused over two issues e.g. (i) Criteria for selecting a new batsman, (ii) Number of opportunities to be given to an under performing batsman before dropping him from their ODI squad. The Domestic level performance records are generally used for selecting a new batsman in an ODI squad but there is a huge difference between domestics and international cricket environments. Sometimes co-relation between domestic records and international performance remains absent. On the other hand, recent past performance records of a batsman are

used as a criteria for retaining him in the ODI squad. However, any batsman can perform or fail to perform in few innings because cricket is a game of glorious uncertainties (Boora, 2006). That is why the selectors with these existing selection tools sometimes select less competent batsmen ignoring more competent batsmen out of the squad. It often creates controversy among the cricket fans regarding integrity of the selectors. An effort has been made here in this paper to develop another tool for the ODI selectors with which they can assess Competency Levels and the Probability of Success of all prospective batsmen before final selection of the batsmen for their ODI teams.

METHODOLOGY

Theoretical Background

Performances of any Batsman in ODI matches depend on the individual attributes as well as the other factors of the rest of the Universe including uncertainties of bowling and fielding performances of the oppositions, pitch and weather conditions, run rate pressures, bio-psychological factors of the batsmen, etc. Thus like other activities, success or failure of a batsman for scoring at least fifty runs in any ODI match is also probable. The Probability of Success of a batsman for scoring at least fifty runs in any ODI match is,

$$P_s = \frac{1}{\left(1 + \mu e^{-\tau\Psi}\right)} \qquad \ldots(1)$$

Here P_s is the Probability of Success; Ψ is the Competency Level; μ and τ are constants (Chakraborty, 2012). A batsman's Competency Level of batting is a product of Knowledge Level (Φ_K), Skill Level (Φ_S) and Attitude Level (Φ_A) of batting of the batsman (Chakraborty, 2013). Mathematically,

$$\Psi = \Phi_K \Phi_S \Phi_A \qquad \ldots(2)$$

Here Knowledge Level (Φ_K) is the ratio of the score obtained (K) by a batsman in a scale for assessing relevant knowledge to maximum possible score obtainable (K_o) in the same; Similarly, Skill Level (Φ_S) is the ratio of the

score obtained (S) by a batsman in a scale for assessing relevant skills to maximum possible score obtainable (S_o) in the same scale; and Attitude Level (Φ_A) is the ratio of the score obtained (A) by a batsman in a scale for assessing relevant Attitudes to maximum possible score obtainable (A_o) in the same scale (Chakraborty, 2013). Mathematically,

$$\Phi_K = \frac{K}{K_0} \qquad \ldots(3)$$

$$\Phi_S = \frac{S}{S_o} \qquad \ldots(4)$$

$$\Phi_A = \frac{A}{A_o} \qquad \ldots(5)$$

If (P_{S1}, Ψ_1) and (P_{S2}, Ψ_2) be the two sets of the Probability of Success and Competency Level of two batsmen the equation (1) can be transformed to,

$$\tau = \frac{1}{\Psi_2 - \Psi_1} ln \frac{(1 - P_{s1}) P_{s2}}{(1 - P_{s2}) P_{s1}} \qquad \ldots(6)$$

$$\mu = \frac{(1 - P_{s2})}{P_{s2}} e^{\tau\Psi_2} = \frac{(1 - P_{s1})}{P_{s1}} e^{\tau\Psi_1} \qquad \ldots(7)$$

The Probability of Success for scoring at least fifty runs in any ODI match is a concept and predicts forthcoming performances of the batsmen but cannot be verified with empirical data. If Competency Level of any batsman changes, his Probability of Success for doing the same will also change. Whereas the Rate of Success for scoring at least fifty runs per effective opportunity in ODI match can be calculated from the statistical data of past performances of the batsmen. and the Rate of Success of a batsman played sufficient number of effective innings is closed to his Probability of Success i.e. $R_s \sim P_s$. Hence, the equation (6) and (7) are can be rewritten as,

$$\tau = \frac{1}{(\Psi_2 - \Psi_1)} ln \frac{(1 - R_{s1}) R_{s2}}{(1 - R_{s2}) R_{s1}} \qquad \ldots(8)$$

$$\mu = \frac{(1 - R_{s2})}{R_{s2}} e^{\tau \Psi_2} = \frac{(1 - R_{s1})}{R_{s1}} e^{\tau \Psi_1} \qquad \ldots(9)$$

The Rate of Success calculated after performances and the Probability of Success assessed before performances are not the same. There may or may not have any correlation between these two variables. The strength of correlation between the Rate of Success and the Probability of Success should be investigated by finding Correlation Coefficient (r) between the two variables. The Pearson's Correlation Coefficient (r) between the Rate of Success and the Probability of Success is given by:

$$r = \frac{n(\Sigma R_s P_s) - \Sigma R_s P_s}{\sqrt{\left[n\Sigma R_s^2 - (\Sigma R_s)^2 \right]\left[n\Sigma P_s^2 - (\Sigma P_s)^2 \right]}} \qquad \ldots(10)$$

If r < -0.7, there will be strong negative linear relation between Rate of Success and the Probability of Success; if r ~ 0, there will be no relation between Rate of Success and the Probability of Success; and if r > +0.7, there will be strong positive linear relation between Rate of Success and the Probability of Success (Rumsey, 2011).

Subjects

Seven contemporary batsmen of Team India namely (i) Virat Kohli, (ii) MS Dhoni, (iii) Lokesh Rahul, (iv) Rohit Sharma, (v) Ajinkya Rahane, (vi) Manish Pandey and (vii) Suresh Raina are selected for the purpose of studying their probability of success for scoring at least fifty runs in any ODI match whenever they will get an effective opportunity to do so.

Basic Assumption

It has been assumed here that all batsmen playing ODI matches must have all the relevant knowledge for batting. Therefore, $K = K_o$ i.e. $\Phi_K = 1$

Hence, the equation (2) will transform to,

$$\Psi = \Phi_s \Phi_A \qquad \ldots(11)$$

Procedure

The responses of cricket fans are used for assessing Skill Levels and Attitude Levels of the selected batsmen. A survey questionnaire is designed with 12 (twelve) items for collecting the responses from the cricket fans. Eight items of equal weightage out of the twelve items are for describing skills and rest four items of equal weightage are for describing attitudes of the batsmen. Every item could be responded with either one option of excellent, very good, good, average, or poor. The survey responses are collected from 52 (fifty two) randomly selected cricket fans from Kolkata, North 24 Parganas and South 24 Parganas districts of West Bengal, India. The survey outcomes are converted to numerical data by assigning 4 for excellent option; 3 for very good option; 2 for good option; 1 for average option; and 0 for poor option in each of the item of the questionnaire.

RESULTS

The computations of the Competency Levels of the seven batsmen by using equations (4), (5), (11) and the obtained average scores of the survey outcome on 'Skill' and 'Attitude' components of the batsmen are reported in Table 1. The Competency Levels of Virat Kohli ($\Psi=0.872$) is > Lokesh Rahul ($\Psi=0.714$) > MS Dhoni ($\Psi=0.692$) > Ajinkya Rahane ($\Psi=0.557$) > Rohit Sharma ($\Psi=0.536$) > Suresh Raina ($\Psi=0.469$) > Manish Pandey ($\Psi=0.405$) (Table 1). The Competency Levels indicate the quality of the batsmen but cannot predict the Probability of the batsmen for scoring at least fifty runs in any ODI match. The calculation of the Rate of Success of each of the seven batsmen from the ratio of number of times he scored fifty runs or more to the numbers of effective opportunities he had for scoring fifty runs is reported in Table 2. Numbers of not out innings of a batsman without scoring fifty runs are deducted from his total number of innings to determine number of effective opportunities he had for scoring fifty runs or more. The Rate of Success of Virat Kohli ($R_S=0.402$) is > Lokesh Rahul and MS Dhoni ($R_S=0.333$) > Rohit Sharma ($R_S=0.293$) > Manish Pandey ($R_S=0.286$) > Ajinkya Rahane ($R_S=0.261$) > Suresh Raina ($R_S=0.246$) (Table 2). The Rate of Success of the batsmen is calculated from the statistical data of their past performances. Here MS Dhoni and Suresh Raina are found to have had most number of effective opportunities e.g. 213 and 167 respectively among the

Table 1: Competency Levels of the seven batsmen on the basis of the survey responses

Batsman Name	Average Scores of Skills in the scale (S)	Maximum possible Scores of Skills in the scale (S_o)	Skill Level ($\Phi_s=S/S_o$)	Average Scores of Attitudes in the scale (A)	Maximum possible Scores of Attitudes in the scale (A_o)	Attitude Level ($\Phi_A=A/A_o$)	Competency Level in the scale ($\Psi=\Phi_S\Phi_A$)
Virat Kohli	29.692	32	0.928	15.039	16	0.940	0.872
MS Dhoni	24.673	32	0.771	14.365	16	0.898	0.692
Rohit Sharma	23.788	32	0.743	11.538	16	0.721	0.536
Lokesh Rahul	26.538	32	0.829	13.769	16	0.861	0.714
Ajinkya Rahane	25.038	32	0.783	12.115	16	0.757	0.593
Manish Pandey	21.904	32	0.685	9.462	16	0.591	0.405
Suresh Raina	23.135	32	0.723	10.385	16	0.649	0.469

Table 2: Rate of Success of the seven batsmen

Batsman Name	No of ODI played	Nos of Innings played (I)	Nos of Not out without scoring 50 runs (P)	Nos of effective opportunities for scoring 50 or above runs (N=I-P)	Nos times Scored 50 runs or above (S)	Rate of Success ($R_s=S/N$)
Virat Kohli	179	171	7	164	66	0.402
Lokesh Rahul	6	6	0	6	2	0.333
MS Dhoni	286	249	36	213	71	0.333
Ajinkya Rahane	73	71	2	69	18	0.261
Rohit Sharma	153	147	14	133	39	0.293
Suresh Raina	223	192	25	167	41	0.246
Manish Pandey	12	9	2	7	2	0.286

Source: http://www.howstat.com/cricket/Statistics/Players/PlayerMenu.asp

seven batsmen for scoring at least fifty runs in ODI matches (Table 2). Thus, their R_S are considered to be approximately equal to their P_S and used for calculating the value of the constants μ and τ. The calculation of the constants μ and τ from the equations (8) and (9) is presented in Table 3. The computation of the Probability of Success of each of the seven batsmen for scoring fifty runs or more in ODI matches by using equation (1) for the value of his Competency Level (Table 1), for μ=7.499 and τ=1.908 (Table 3) is reported in Table 4. The Probability of Success of Virat Kohli (P_S=0.413) is > Lokesh Rahul (P_S =0.343) > MS Dhoni (P_S =0.333) > Ajinkya Rahane (P_S =0.292) > Rohit Sharma (P_S =0.271) > Suresh Raina (P_S =0.246) > Manish Pandey (P_S =0.224) (Table 4). The comparison between R_S and P_S of the seven batsmen is presented in Fig. 1. The calculations

of the Pearson's Correlation Coefficient between the R_S and the P_S and the deviations of the R_S from the P_S of the rest five batsmen i.e. Virat Kohli, Rohit Sharma, Ajinkya Rahane, Lokesh Rahul, and Manish Pandey are reported in Table 5. The Pearson's correlation coefficient between the R_S and the P_S of Virat Kohli, Rohit Sharma, Ajinkya Rahane, Lokesh Rahul, and Manish Pandey is 0.8709 (Table 5). The variation of the magnitude of the deviation of the R_S from the corresponding P_S with the number of effective opportunities reported in Fig. 2.

DISCUSSION

The ranks of all the seven batsmen in respect of the P_S are not the same as that of the batsmen in respect of the R_S but the figure showing the data of the R_S and the P_S plotted against the Competency Levels of the batsmen

Table 3: Constants μ and τ

Rate of Success of MS Dhoni (R_{S1})	Rate of Success of Suresh Raina (R_{S2})	Competency Level of MS Dhoni as per the survey (Ψ_1)	Competency Level of Suresh Raina as per the survey (Ψ_2)	Value of in the scale	Value of in the scale
0.333	0.246	0.692	0.469	1.908	7.499

Table 4: Probability of Success of the seven batsmen

Batsman Name	Competency Level (Ψ)	Probability of Success (P_S)
Virat Kohli	0.872	0.413
Lokesh Rahul	0.714	0.343
MS Dhoni	0.692	0.333
Ajinkya Rahane	0.593	0.292
Rohit Sharma	0.536	0.271
Suresh Raina	0.469	0.246
Manish Pandey	0.405	0.224

Table 5: Deviation Rates of Success from Probability of Success and Correlation Coefficient between the two

Sl. No (n)	Batsman's Name	Nos of effective opportunity (N)	Rate of Success (R_S)	Probability of Success (P_S)	Deviation $\delta = |R_S - P_S|$	Pearson's Correlation Coefficient (r)
1	Lokesh Rahul	6	0.333	0.343	0.010	
2	Manish Pandey	7	0.286	0.224	0.062	0.8709
3	Ajinkya Rahane	69	0.261	0.292	0.031	
4	Rohit Sharma	133	0.293	0.271	0.022	
5	Virat Kohli	164	0.402	0.413	0.011	

(Fig. 1) indicates that there is a correlation between the R_S and the P_S of the batsmen for scoring at least fifty runs in any ODI cricket match. It is mention worthy that the R_S and the P_S of MS Dhoni and Suresh Raina are exactly the same because they are considered as the reference batsmen for calculating values of the constants μ and τ. There is a strong positive linear relationship between the R_S and the P_S because the Correlation Coefficient (0.8709) between the R_S and the P_S is greater than +0.7 (Table 5). The magnitude of the deviation of the R_S from the corresponding P_S decreases with the increases of number of effective opportunities (Fig. 2). Thus the R_S has a tendency to become closer to the P_S after an adequate number of effective opportunities. The R_S of Lokesh Rahul is already much closer to his P_S though he played only six innings of ODI matches. Lokesh Rahul is in a very initial stage of his ODI batting carrier and his R_S may be deviated further from P_S in the next few ODI matches. It's noteworthy that there will be no deviation here for MS Dhoni and Suresh Raina because they are considered as reference batsmen for computing value of the constants μ and τ.

LIMITATIONS AND FUTURE RESEARCH

There are some limitations in this study which may include some errors in the results and can be minimised

in future research. Firstly, the survey outcome does not contain the opinions of any recognised cricket expert.
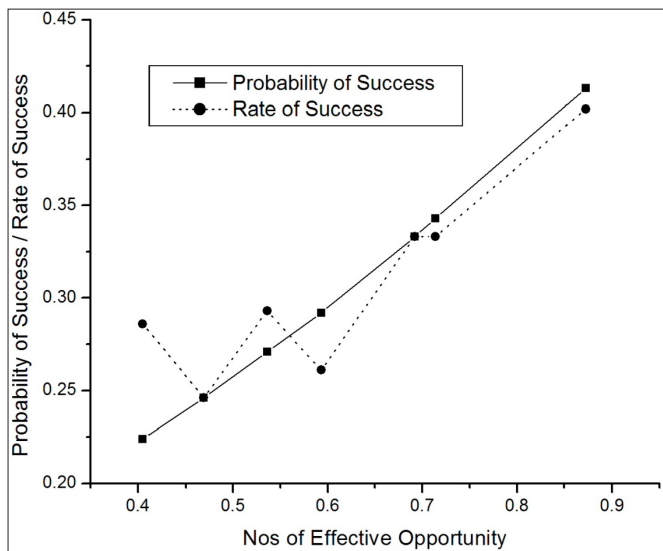

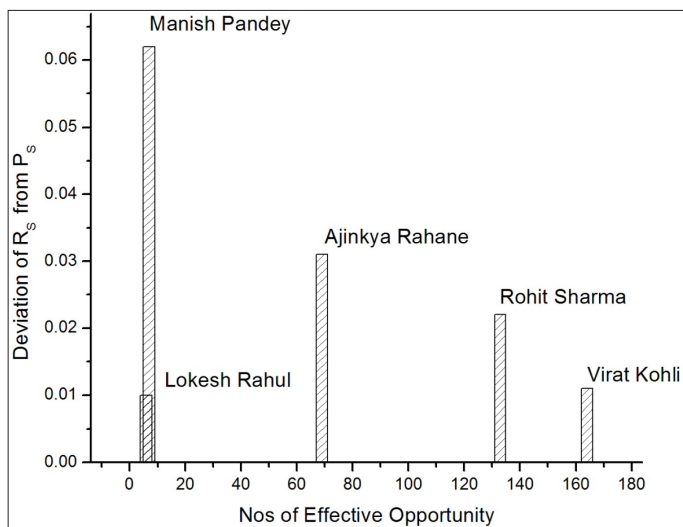**Fig. 1:** Showing the Comparisons between Rates of Success and Probability of Success

Fig. 2: Showing the Variation of the Deviation of Rates of Success from Probability of Success with the number of effective opportunities

If survey responses were collected from the cricket experts instead of the cricket fans the computation of Competency Levels would have been more valid and reliable. Secondly, the Rate of Success and the Probability of Success of the two reference batsmen are

considered equal for calculating the constants μ and τ. This also includes some errors in the computation of Probability of Success because the Rate of Success and the Probability of Success are not the same. However, the two batsmen, who played the most number of innings out of the seven batsmen, have been selected here in this paper for minimising this error while calculating the constants μ and τ.

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CONCLUSION

The Probability of Success a batman for scoring some specific runs or above in any One-Day International cricket match is assessable with his Competency Level of batting. There is a strong positive linear relationship between the Probability of Success of any batsman while the Probability of Success is assessable before his actual performances and his Rate of Success in the ODI cricket matches and the Rate of Success of any batsman has tendency to become closer to his Probability of Success after adequate number of effective opportunities. Thus this paper has a capacity to encourage the selectors of cricket teams for using the concept of the Probability of Success instead of the statistical records of performances in selecting batsmen for their teams.

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