

MODIFIED DUCKWORTH-LEWIS METHOD FOR THE PREMATURE TERMINATION OF A MATCH IN THE SECOND INNINGS

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Introduction

Unlike most of the other sports, in the case of the game of Cricket, the rain and the bad light often interrupt and sometimes completely halt a match. The type of clement weather required by the game of Cricket is not guaranteed for every match. The prevailing weather during the time of a match affects the fortune of the two teams very differently. The interruption may occur in various different ways depending upon the point of the game. Thus, it is utmost important to determine a target score in such a way that the probability of winning is preserved across the interruption.

In early days, a method based on average run rate was utilized in which the first innings score was scaled down to set the target for the side that bats second. This method clearly favored to side batting second. Then in the fifth Cricket world cup, for the first time, a method based on the most productive overs was introduced in which the target was set by reducing the runs scored in the lowest scoring overs. This method turned out to be extremely unfair for the team batting second. The strengths and weaknesses of the available methods were summarized by Duckworth and Lewis (1998), whose own rule (D/L method) has attracted significance attention due to its relative fairness.

The D/L rain rule remained unchallenged for some time. Later due to the heavy scoring occurred in one day internationals, the aforementioned rule was adopted for the matches with the first innings score greater than 235. With the current setup, the original rain rule is applied only for the matches in which the first innings score is less than 235. For the matches with first innings score greater than 235, an entirely different formula which is available to the authorities of Cricket only, is applied. The significance of a score of 235 is neither factual nor obvious. Recently, on several occasions, the D/L method is severely criticized due to its pitfalls and associated unfairness.

In this endeavor, the objectives are twofold. In the first, the attention is focused to the accuracy of the original D/L method in determining the winner in the case of a premature termination of a match and in the second, it is attempted to modify the D/L method by introducing some other factors which are not considered in the original D/L method.

Methodology

For this purpose, a random sample S_i of 150 completed encounters distributed uniformly between the 1500th and the 3000th matches was selected. Then, the close encounters

were filtered out by discarding the matches ended with margins greater than 30 runs or more than three overs spared. The new sample S consists of 26 sample points. Then, the D/L method is applied assuming each of the match in the sample experienced a premature termination at the end of over number $(20+k)$ with $k=0, 1, 2, \dots, 29$. Then the results predicted by the D/L method are compared with the actual results and are tabulated in Table 1.

As indicated in Table 1, anticipated application of the original D/L method possesses a very low reliability, in particular, between over number 20 and 35. In order to develop a new technique by modifying the D/L method slightly, the following notation was used. Let n and r be the total number of overs (usually 50 for a one day international) and the number of overs bowled respectively. If number of wickets remaining is w , for any first inning total τ , let the target score obtained by the D/L method be $s(\tau, n-r, w)$.

Then, a multidimensional regression analysis is employed to devise the modified target score $m(\tau, n-r, w, b, c)$ given by

$$m(\tau, n-r, w, b, c) = s(\tau, n-r, w) + \varepsilon, \text{ where}$$

$$\varepsilon = \frac{\tau r(n-r)}{n^2} [\gamma(b) + \sqrt{\pi e} \frac{(5n-\tau)}{(5n-\tau)} \tanh\left(\frac{\tau-5n}{5n}\right) + \frac{1}{\sqrt{\pi e}} \tanh(c)]$$

with $b \in (0,1)$,

$$\gamma(b) = \begin{cases} 0.3 & b = 0 \text{ (Day match)} \\ 0.6 & b = 1 \text{ (D / N match)} \end{cases} \text{ and}$$

$$c = \frac{l-w}{11-w}$$

with l is the lowest position of the batsman at the wicket by the time of the application of the rule.

Results

The Table 1 indicates the comparison of the predicted results by application of the D/L method and the method proposed in this work.

Discussion

Encounters terminated prematurely in the second inning comprise approximately 42% of the interrupted matches. It turns out that the method proposed in this endeavor is more effective than the D/L method in choosing the winner in the close encounters of this large class in particular between the 20th and the 40th overs. In particular, the modified formula stands out significantly over the existing method in the case of day and night matches as well as the high scoring matches. By changing γ by taking the statistics of the venue at which the match is played, these results can be improved immensely. It is extremely tedious

Conclusion

It was an extremely tedious exercise to devise a general model for the aforementioned prediction to capture sudden collapses and pinch-hitting occurred in some of the close encounters in the sample S . Moreover, the D/L method is partially based on w , which is not a very decisive factor in the modern day of Cricket, any modification of this predictive technique has its own limitations. This motivates in devising new techniques which are based on the required run rate, the quality of wickets at hand both in terms of the batting averages

and striking rates, the quality of bowlers available to the fielding side, statistics of the venue at which the game is played, the dew factor, number of overs left in the batting power play etc.

Resetting the Target in Interrupted One-Day Cricket Matches. Journal of the Operational Research Society, 49: 220-227.

Preston, I. Rain Rules for Limited Overs Cricket and Probabilities of Victory.

References

Duckworth, F.C. and Lewis, A.J. (1998). A Fair Method for

Table 1. Comparison between the D/L method and the proposed method.

Overs	All				Day/Night				Score>=250				Score<250				Score<235			
	D/L		Modified		D/L		Modified		D/L		Modified		D/L		Modified		D/L		Modified	
	Result		Result		Result		Result		Result		Result		Result		Result		Result		Result	
	C	W	C	W	C	W	C	W	C	W	C	W	C	W	C	W	C	W	C	W
20	3	23	11	15	1	9	5	5	2	14	9	7	1	9	2	8	0	5	0	5
22	4	22	13	13	0	10	5	5	3	13	11	5	1	9	2	8	0	5	1	4
24	3	23	13	13	1	9	5	5	2	14	11	5	1	9	2	8	0	5	1	4
26	5	21	13	13	1	9	4	6	3	13	10	6	2	8	3	7	1	4	2	3
28	5	21	12	14	1	9	3	7	3	13	9	7	2	8	3	7	1	4	2	3
30	7	19	13	13	2	8	5	5	5	11	11	5	2	8	2	8	0	5	1	4
32	10	16	13	13	1	9	5	5	6	10	11	5	4	6	2	8	1	4	1	4
34	11	15	14	12	3	7	5	5	6	10	10	6	5	5	4	6	2	3	3	2
36	11	15	14	12	2	8	6	4	6	10	9	7	5	5	5	5	2	3	3	2
38	12	14	14	12	2	8	6	4	6	10	10	6	6	4	4	6	2	3	2	3
40	14	12	15	11	4	6	7	3	7	9	11	5	7	3	4	6	3	2	3	2
42	17	9	16	10	6	4	7	3	10	6	11	5	7	3	5	5	3	2	3	2
44	18	8	16	10	6	4	7	3	11	5	12	4	7	3	4	6	4	1	3	2
46	21	5	19	7	8	2	8	2	13	3	12	4	8	2	7	3	4	1	4	1
48	20	6	18	8	8	2	8	2	12	4	12	4	8	2	6	4	4	1	4	1
50	26	0	26	0	10	0	10	0	16	0	16	0	10	0	10	0	5	0	5	0

Note: C- Correct results W-Wrong results