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## Mathematical Suggestions to the D/L Rain Method

Prasant Nair<sup>1</sup>

Former student, Co-operative College, Jamshedpur, Jharkhand, India

**ABSTRACT:** This paper presents mathematical suggestions to the most used rain rule, the Duckworth Lewis method in cricket, used for resetting the match score. IPL Sunrisers team's coach Tom Moody, and innumerable cricketers, statisticians are feeling the need for a correction in the method. Nobody has yet come out with a single solution, common to t20 and ODI, feeling that a 'single' solution is not possible. But this paper easily traces a natural mechanism common to T20 and ODI, namely an 'integer partition' in the form of ' $90n + 30$ '. Further, it reviews and analyzes the various sections of the D/L method employed in cricket, in the light of modular mathematics, congruence and presents great many surprising things and practical solutions for the ICC to consider.

**KEYWORDS:** Duckworth Lewis method, integer partition, opening batsmen data, cricket match score, linear congruence equation, cricket score correlation. .

### I. INTRODUCTION

In a report published on May 16, 2015, Sunrisers Hyderabad coach Tom Moody has expressed unhappiness at the way the target for Royal Challengers Bangalore was revised under the Duckworth/Lewis method in their rain-interrupted IPL cricket match and said that the system 'needs to be looked at'. Moody is still disillusioned how D/L method comes up with the numbers that they come up with. [1] [2]. V Jayadevan reviews the changes made in the D/L method and feels to the extent that the revised method is equally defective [3] [4]. The D/L method has been critically reviewed by vast many cricket experts over the years [5][6]. More common informal criticism from cricket fans and journalists of the D/L method is that it is unduly complex and can be misunderstood [7]. Till the end of August 2012, the D/L method has been used in 189 T20 matches, of which 181 have produced a result. Of these, 90 have been won by Team 1, 84 by Team 2 and 7 have been tied [8]. The incidence of cricket match interrupted due to rains are increasing over the years, so the matter is serious. Duckworth and Lewis have collected the T20 data, ODI data related with International matches only, leaving out the domestic t20 series which are over 500 in count every year. They are reluctant in incorporating the data of domestic t20 cups, namely, the Indian Premier League, Ram Slam challenge, Big Bash, Bangladesh Premier League, Haier Cup, Caribbean Premier League and others. But at the same time, enforcing their D/L target on these matches too. The cricket community is feeling the need for a correction, few changes in the D/L method. Nobody has yet come out with a single solution, common to t20 data and ODI data, feeling that a 'single' solution is not possible. It is not so, a simple research tells us that an integer partition of the form ' $90n + 30$ ' is common to t20 and ODI data, it has been presented in this paper. And further, this paper traces similar kind of 'integer partition' in all the cricket scores with  $90n$  acting as the anchor points. Then, in the next section, which is the core of our methodology, we re-group the data in the live scorecard, add the balls faced count to the runs count of each wicket batsman. Through this we establish an indisputable existence of linear congruence between the batsman's data and the team total score. Immediately follows the mathematical suggestions to the D/L method. The paper further explains in details point wise modifications to various aspects of the method. These integer based suggestions have been developed to be presented for consideration by the ICC review committee..

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## A. Integer Partition

The target score is mostly visioned as consisting of two parts. At the stage of interruption, the team is at  $S_0$  runs, and after resumption of play, they might add few more runs say  $S_1$  to the score, making the total score to  $S = S_0 + S_1$ . So, the revised target will be set keeping in mind both the sections of the play. In the CRR method, the additional runs required to be scored  $S_1$  will be the run rate based on current score,  $S_0$ , multiplied by possible overs after the rain stoppage.

In the existing DLS method, under certain conditions, Sir Duckworth Lewis is currently splitting the target scores into two parts- first part G50 value which depends on the format of the match- T20, ODI, women' cricket etc. These values have been revised over the years, from 225 runs to 245 etc. And the other part, as said earlier, the match specific value to be calculated based on current status of the match- the overs remaining, and the wickets left.

Score (S) = G50 value + Match Specific value

Since cricket scores are integers, this type of split in target scores is analogous to integer partition. For example 4 (positive integer n) can be partitioned in five distinct ways using number theory and combinatorics, called as integer partition-

4

3 + 1

2 + 2

2 + 1 + 1

1 + 1 + 1 + 1

In cricket, it shouldn't make a difference whether we are developing a target score method which is uniting 3 split scores rather than 2, or 4 splits etc. And it is upon us to wisely develop the split parts of the target score so that it represents 'fairness' to both the teams, and it traps the natural mechanism of cricket score. A highly generalized target score on the lines of integer partition seems to be something like this-

Score (S) = Base/Constant + Match Specific value

## B. Natural Partition In Cricket Scores

Nobody has yet come out with a single, satisfactory solution, common to both the formats of the cricket match, namely t20 and ODI. The existing D/L method is employing the same table alike in T20 and ODI matches, almost forcibly. The table suggests at 56.6% resource available at the start of the innings in a T20 match, not 100%! In the thesis work, Muhammad Asif statistically proves that it is justifiable to combine the data of the two formats and fit a single model for both ODI and T20I cricket interruptions [9]. But the vast majority of statisticians are feeling the need for different approaches for the two formats[10] And strangely, Duckworth himself feels the 'different' needs of Twenty20 cricket. A report in the Guardian [year 2009] claims that the Duckworth-Lewis system used in rain-affected matches will be reviewed in the coming months to take into account Twenty20 matches [11].

But wait, one can mathematically relate both, T20 and ODI at par in a single shot, without any past data, statistics or complex functions. A careful observation reveals a base of 90n which is common to both the versions of cricket, namely, ODI and T20 as illustrated in **Table 1**.

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**Table 1:** Natural partition common to T20 and ODI

Format	Balls	Split	
T20	120	90	30
ODI	300	270	30
<b>Common</b>	$90n + 30$		

The balls, written in the above table, represents the total balls count which in a t20 match is 120, and in an ODI is 300. T20 balls count has a natural split of 90 plus 30. And the ODI balls count, has the natural split 270 plus 30. Mathematically, it is remainder values mod 90. If n represents the multiples of 90, in t20 this value is 1, and in ODI, n=3. As evident, we arrive at a pattern,  $90n + 30$ , common to T20, ODI. This is associated with 'score' too.

In any match, the batting side is expected to score runs at least par with the total balls count. In a t20 match, the batting side is expected to score at least 120 runs, which is equal to 20 overs = 120 balls. Similarly, in an ODI match, the batting side is expected to score at least 300 runs [=300 balls]. Note carefully, both have exactly same remainder value 30 when divided by 90n

There is a natural scientific or mathematical mechanism in every phenomenon and so exists in cricket and cricket scores. The actual scores, too, are getting developed around these anchor points represented by multiples of 90 i.e. 90, 180, 270 etc as illustrated in **Table 2**. This is quite 'consistent' with the natural integer partition ' $90n + 30$ ' in the balls count or say minimum runs expected. The data is well researched, unbiased, taken from all the matches since the beginning of cricket..

**Table 2:** Natural Integer Partition In Actual Score

Date	Match	Score	Integer partition	
11 June 1975	Pakistan v West Indies	266	270	-4
27 November 1979	Australia v West Indies	193	180	13
25 June 1983	India v West Indies	183	180	3
11 February 1984	Australia v West Indies	222	180	42
18 April 1986	India v Pakistan	245	270	-25
13 April 1984	India v Pakistan	188	180	8
17 November 1985	India v Pakistan	203	270	-67
7 April 1986	New Zealand v Pakistan	214	180	34

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There is a natural tendency in the actual scores to stick around the nearest 90n, like as shown in table, the natural split in score 266 is 270 and (-)4. The half of 90 is 45, so, anything higher than that too, like the 67, is getting reduced from the 270. It is of course, case specific, related with the live data because the 203 can split as 180 plus 23 too.

D/L or other existing methods are utilizing the average value of runs from the set of previous 10-20 years of cricket matches, allotting different values for men' team, women' team, T20, ODI etc. In the D/L method (now also known as DLS method), this base value is called as G50 value and its value is 245 runs. The selection of base value, should have been visioned and developed as 90n or at least multiples of nine, but 245 seems to be inconsistent with the observed natural 90n base. The natural kind of integer partition common to T20 and ODI is absent in the DLS, VJD or any other target score.

Interestingly, natural division of the scores helps establish the following-

1. erasing the misconception that T20 score needs different treatment than the ODI score.
2. highlighting at the possibility of a single common formula to both the formats of the cricket- ODI as well as T20 [the same is applicable on test matches also]. With these important points in mind, one can develop a powerful scientific target formula.

$$\text{Score (S)} = 90n + \text{Match Specific value}$$

### C. Live Data, No Past Data Please!

The DLS method [12] is using past data in two ways- 1) the resource percentage table, 2) the G50 value. The family of curves [Figure 1] are based on the data taken from the 'past' hundreds of one-day matches which has then been converted to resource percentage table [figure 2].

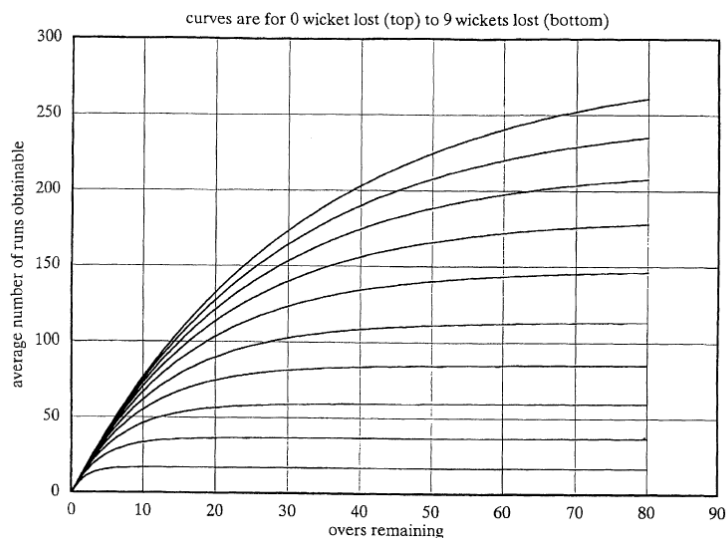


Figure 1: The family of scoring curves in the D/L method.

The essence of the D/L method is 'resources'. Each team is taken to have two 'resources' to use to make as many runs as possible: the number of overs they have to receive; and the number of wickets they have in hand. The family of curves, 10 in total, representing the wickets count, gives the average proportion of the possible runs in an innings with u overs

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to be bowled and wickets down. As the wickets go on falling, the team steps down to lower order curves, with a sharp decrease in possible runs if it happens at a stage when more overs are remaining.

The main point is that the family of curves is based on past data, it has nothing live in it. Also, statistically, it can be proved that not many matches go down the wire, in several thousand matches, the result has happened without the utilization of all the ten wickets.

<i>Wickets lost</i>	<i>0</i>	<i>2</i>	<i>4</i>	<i>9</i>
Overs left 50	100	83.8	62.4	7.6
40	90.3	77.6	59.8	7.6
30	77.1	68.2	54.9	7.6
25	68.7	61.8	51.2	7.6
20	58.9	54.0	46.1	7.6
10	34.1	32.5	29.8	7.5

**Figure 2:** An abstract from the D/L table of resources

The same curve has been converted by Duckworth Lewis into a table of resource values, as shown in the figure 2, and it is used by the umpires in the field during the match. Again, this is a repetition of the past data only. And further, it carries with the major defect that it is non integer. The target score formula must necessarily avoid, as far as possible, such functions/values which would create non integers because cricket scores are always integers, in a natural manner. Further, the resource table hints at 100 percent at 50 overs, mainly an ODI. A t20, which is a 20 overs format has just 58.9 percent resource at this disposable in the beginning of the innings itself, all the overs remaining, 10 wickets left.

Next past data is the G50 value. Among the three conditions stated, when the resource of Team 2 is greater than that of Team 1, i.e. when  $R_2 > R_1$ , the revised target is calculated as  $T = S + G(N) (R_2 - R_1)$ , where the G/G50 represents the average 50 overs total calculated on the basis past scores in general.

In the fast paced modern cricket, 10-15 matches are being played each day, the players are regrouped into newer teams or shifted to other teams. Past trends or data have no meaning in such cases. Also, the count of past T20s and ODIs is so large that one can't find the true average values of score, every researcher presents his own version of the average value, and this is a disputable point. Muhammad Asif claims the average values for the t20 to be 151 runs, and 245 for the ODIs.

## II. RELATED WORK

### A. Sir William Elterton's Work

Much before even Duckworth Lewis method came into being, the statisticians have been trying to trace some sort of notable pattern in the scoring of the batsman. If any pattern is present, it can be used for forecasting the scores in cricket, re-setting the target scores, though they were not doing the research with that aim. The works of G.H. Wood and Sir William points, related with test cricket, points out the presence of geometric progression in the overall scoring pattern of a batsman, his score  $n$  may advance to  $n + 1$  runs. More important were his spotting an appreciable correlation between the sum of the scores of two opening batsmen and the team score in an innings. And he needed any other method, rather than commonly used, to develop and establish this concept [13]. In this paper, we have extensively used their concept that the scores of the first two wicket matters the most, and they serve as the sample to the team score, directly, without passing through any exponential or log or such functions which change the nature of the sample itself. And has given few new mathematical tools to his outlook- the 'modular' analysis and the linear congruence equation.

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## B. Modified Duckworth Lewis Methods

In the light of heavy criticisms, several modified D/L methods have been proposed by statisticians, researchers, cricket experts. Jayadevan presents his VJD method [14], as early as, in 2002 with a brighter concept of dividing the scoring into 7 parts, and his version of the resource table. Stern proposes changing, again, the resources table of the D/L method in the second innings to better reflect how teams batting second are able to adopt a different strategy from the team batting first [15]. Bhattacharya, too, presents a new table for the Duckworth Lewis method based on a non-parametric approach for T20 cricket [16]. Preston and Thomas adopts an interesting variation, presents a method for adjusting targets that preserves the probability of victory for the first batting. This has found to be quite near the natural winning mechanism in cricket, which is one of the main part of this paper, and has been detailed in later sections. But mostly, the previous suggestions revolve around trying a different variation of the resource table.

The main complaint to be made is that most of the study and analysis of the Duckworth Lewis, D/L method has been limited to the vision that the makers of the method has provided. It is not necessary at all to relate cricket with 'resources' A simple walk through the natural mechanism of cricket, in the introduction section itself of this paper, has provided the correct means and methods to remove the flaws in the Duckworth Lewis method, and equally to develop a much stronger error free target score formula.

## III. PROPOSED METHODOLOGY

### A. Data Correction: The 'Row' Approach

A sample scorecard [figure 3] has been created for our experiment. 'R' has been used to suggest runs, and 'B' for the balls count. At any stage of the match, if n wickets have fallen, there will be one or two additional 'not out' batsmen. While  $R_1, \dots, R_2, \dots, R_{n+2}$  would represent the scores of the each fallen wicket batsman, the current score [assuming no extra runs] would be represented by  $R = \sum_{i=1}^{n+2} R_i$ . Likewise,  $B_1, B_2, B_{n+2}$  would represent the balls faced by each batsman, and  $B = \sum_{i=1}^{n+2} B_i$  the total number of balls till that stage of the match.

The target score is computed on the basis of current score  $S_0$ , as stated in the 'integer partition' section, or on the basis of the resource table, as in the DLS method [figure 2] which in turn is based on the remaining overs and wickets lost. All these data, the current score, the total balls count are extracted from the columns of the live scorecard.

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**Table 3:Turning the Column Data Into Row Data**

Sample Scorecard: Method of Turning the Column Data Into Row Data						
First Team innings (LHS)						
Batsman (wicket)	Runs Scored		Balls Faced			
2	R <sub>2</sub>	+	B <sub>2</sub>	=	W <sub>2</sub>	
n	R <sub>n</sub>	+	B <sub>n</sub>	=	W <sub>n</sub>	
1	R <sub>1</sub>	+	B <sub>1</sub>	=	W <sub>1</sub>	
n + 1	R <sub>n+1</sub>	+	B <sub>n+1</sub>	=	W <sub>n+1</sub>	
n + 2	R <sub>n+2</sub>	+	B <sub>n+2</sub>	=	W <sub>n+2</sub>	
Total	$R = \sum_{i=1}^{n+2} R_i$	+	$B = \sum_{i=1}^{n+2} B_i$	=	$W = \sum_{i=1}^{n+2} W_i$	
Wickets count	Total Score		Total balls ∈ {120,300}			

In our experiment, we attempted a ‘re-positioning/grouping’ of the entire data, as illustrated in Table 3. Keeping the total data equal, we regrouped the balls faced by each batsman with his own runs scored data. The same data, i.e. the columnar data, is now represented as row data, in the form of batsman’s data, W<sub>1</sub>, W<sub>2</sub>...W<sub>n+2</sub>, as shown in the table. Now each batsman’s data is like a sample to the team score, and can be picked individually for study.

### B. Batsman’s data (runs + balls) ≡ Team total Score

Next we investigated whether there is any meaningful relation between batsman’s data with the team total score? As soon as we performed this regrouping, added the balls faced count to his runs, its strong relation with the team total score almost ‘popped’ out. We find that, in almost every match, the remainders of the batsman’s data and the team score are equal when divided by 90 or 9.

A simple example, the batsman’s data is 34 and the total score is 241. When we remove/cast out all nines from both the numbers, we get-

$$34 - 27 = 7 \text{ and } 241 - 234 = 7$$



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Means, given the first or second batsman's data, the total score would always come in such a value, S, that both, W and S will have the same remainder once all nines have been removed from their values. In many matches, it is the additive inverse of the Score. This is a case of linear congruence, the Score is always congruent to the batsman's data modulo 9.

In mathematical terms, this is written  $S \equiv W \pmod{9}$ .

## C. Effect of congruence

It has been observed that this 'congruence' has a strong impact on cricket, the match outcome, itself, depends on equality between remainders. When the remainders are equal, it results in the victory for the first batting team. In special cases when there is an extra 9 in the data, or else the digit roots are unequal, the chasing team wins. Let  $W_i$  represent the batsman's data, and S be the score, then-

### Results in a win:

$W_i \pmod{9} = S \pmod{9}$ , results in a win for the first batting team, where  $W_i \in \{W_1, W_2\}$  i.e. the data of only the first or second batsman is to be taken for the analysis.

### Doubtful of a win:

$W_i \pmod{9} \neq S \pmod{9}$ , or else there is a '9' in the data. It turns the data into a 'minus' sign.

## D. Testing the D/L target Score

Cricket scores are integers, they are showing direct modularity with the batsman's data. So, firstly we tested the 'congruence' in the D/L target scores. We compiled the data of all the matches in which DL method has been used for resetting the target score. The remainder values, mod 9, better known as digit root, were calculated for the first/second wicket batsman's data, as well as the revised target score set by the DL method and tested for equivalence. We find lack of congruence between them as shown in the **Table 4**. This happens to be the major flaw in the Duckworth Lewis method, and equally in the VJD, other methods. It may be because they have failed to trap the visible, natural mechanism of cricket scores, '90n + 30'.



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**Table 4:**D/L target Score Showing Lack of Congruence

Date	Match	Batsman's data	Digit Root	First innings score	Digit Root	equal?	D/L target	Digit Root	equal?
Jan 1, 1997	Zimbabwe v England	14	5	200	2	No	186	6	No
Apr 12, 2015	Bangladesh v Kenya	17	8	242	8	Yes	166	4	No
Oct 11	South Australia vs Queensland	1	1	280	1	Yes	278	8	No
Oct 12	Tasmania vs NSW	61	7	218	2	Yes	193	4	No
Oct 20	Tasmania v Victoria	95	5	320	5	Yes	279	9	No
Dec 3	Barisal bulls vs Rangpur riders	4	4	104	5	Yes	75	3	No

As revealed by the table 4, while the original score/target is perfectly congruent with the batsman's data, the Duckworth Lewis target score is more than often in-congruent. The congruence can be present in the additive inverse manner, like in the case of Tasmania vs New South Wales match. The remainder of the batsman's data is 7, and that of the first innings team score is its additive inverse, (-)7. If we go deeper, we observe a stunning result. Taking the base as mode 90n, when we subtract the batsman's data 61 from 270 runs, we arrive at 209 runs. And this is at a gap of 9 runs from the actual score 218. The D/L target is completely offtrack, standing at 193. Actually, the target score should pass the 'mod 90' test, but then it would be too much of an expectation from an exponential constant based formula like the D/L method. It is failing at the mod 9 test itself. But this error can be rectified as provided in the later sections of this paper.

### E. Preservation Of Probability Of Victory

The DL rule is not a PP rule and is not intended to be, as the authors make clear that The D/L method maintains the margin of advantage. It does not maintain the probability of winning or losing. But we can't neglect the fact that the natural mechanism of cricket itself is displaying this feature in every match, victory and defeat is happening based on it. Then why not incorporate it the rain rule, after all, the purpose of setting a target by the first team is to challenge the second team. Ian Preston confirms that the objective of the team batting first is to maximize the probability that it sets a target which the second team fails to reach [17]. This paper aims in the same direction .

### F.Congruence Based Target Score Formula

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When  $x \equiv y \pmod{9}$ , this linear congruence relation is represented as an actual mathematical equation [18] [19] in the form of,

$$x=9z+y \dots\dots\dots(1)$$

We employed our batsman's data as the input data,  $y$ , in the above equation (1) to generate the target score  $x$ . The value of  $z$ , in this case of cricket, is to be determined on the basis of scoring rate in that match. It is mathematically accurate because both,  $x$  and  $y$  will have equal remainders. The equation will carry forward the exact value of the input data on to the target score without any pollution. The concept that the batsman's scoring is like a sample to the total score will correctly work through this kind of equation. And the target score will truly be scientific, and mathematical!

## IV. EXPERIMENTAL RESULTS

### A. Working of the Suggested formula

The congruence based formula, developed in the experiment, taking the live batsman's data (runs + balls) was developed into the final form (equation 2) and tested on over 200 past and current matches. The precision is satisfactory, 80%, the error ranges between 7-8 runs only. **Table 5** shows the working of the above formula on a sample of some exciting matches in the recent past.

$$\text{Score} = 90n \pm \text{Batsman's data} \dots\dots\dots(2)$$

**Table 5:** Sample test results of the score formula.

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S.no	Date	Match	Batsman's run + balls	Score formula	Score	Actual score
1.	May 6, 2014	Sri Lanka v Ireland	32	180 + 32	212	219
2.	May 6, 2014	Yorkshire v Northamptonshire	8	180 - 8	172	165
3.	May 9, 2014	England v Scotland	91	180 - 1	179	173
4.	May 22, 2014	England v Sri Lanka	106	270 - 16	254	247
5.	May 25, 2014	England v Sri Lanka	107	270 - 17	256	253
6.	May 28, 2014	England v Sri Lanka	23	90 - 23	67	67
7.	May 31, 2014	England v Sri Lanka	24	270 + 24	294	300
8.	June 3, 2014	England v Sri Lanka	25	180 + 25	205	219
9.	June 15, 2014	India v Bangladesh	23	180 - 23	157	153
10.	June 17, 2014	India v Bangladesh	38	90 - 38	52	58
11.	Jul 5, 2014	New Zealand v West Indies	21	90 + 21	111	132
12.	Jul 6, 2014	New Zealand v West Indies	70	90 + 70	160	165
13.	Sept 7, 2014	India v England	2	180 + 2	182	180
14.	Dec 9, 2015	Barisal Bulls vs Chittagong Vikings	46	90 + 46	136	136

The computation of the correct value of  $9z$  or  $90n$  posed a challenging task, it is yet to some extent unresolved. For commercial confidentiality, its calculation algorithm has not been described here, it has been calculated from the live data itself. In many matches, the score based on this formula has come exactly equal to the actual score/target, and in others, near. Beginning from the top of the list, the Sri Lanka vs Ireland match score, simply adding the 32 to the 180 provided the projected as 212 which is so close to 219, the actual score. Again, the score projection for the England vs Sri Lanka match came as close to 3 runs difference from the actual score. The table provides a sample extracted from a longer list, consecutive matches have been selected intentionally to do away with any bias attitude. In the latest match, Barisal Bulls vs Chittagong Vikings, adding the second wicket batsman's data, 46 to the 90 gave the projected score exactly equal to the actual target 136. This, in turn, validates the 'linear' congruence between the batsman's data and the team score.

### B. Fine Tuning the D/L Target score

Since the main aim of this research work, and the paper is to provide mathematical suggestions to improve the DLS method itself, the nearest approach would be to add or subtract few runs from the target score to be computed under the D/L method so that its remainder  $[\text{mod } 9]$  becomes equal to the remainder of the first/second batsman's data (runs + balls).

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Lets revisit Table 4, find the target score based on the ‘90n batsman’s data’ logic, and compare it with D/L targets.

**Table 6:** Fine tuning the D/L target score

Date	Match	Batsman’s data, $W_i$	First innings score	90n	$90n \pm W_i$	D/L target
Jan 1, 1997	Zimbabwe v England	14	200	180	194	186
Apr 12, 2015	Bangladesh v Kenya	17	242	180	163	166
Oct 11	South Australia vs Queensland	1	280	270	271	278
Oct 12	Tasmania vs NSW	61	218	270	209	193
Oct 20	Tasmania v Victoria	95	320	360	265	279
Dec 3	Barisal bulls vs Prang riders	4	104	90	86	75

Few practical examples have been shown in Table 6 how the ICC can incorporate our suggested method in the existing Duckworth Lewis method, and use it for resetting the target in-play during the match. The Batsman’s data, which is his runs scored plus balls faced value, is represented by  $W_i$ . The data, particularly, need be of the first, or the second wicket batsman. For resetting the target, when there is a rain interruption, the umpires would require only to calculate the value,  $90n \pm W_i$ , taking  $n=1, 2, 3$  such that it is close to the D/L target. Like, in the Bangladesh vs Kenya match, the D/L target is 166, and the suggested target is 163. Again, in the South Australia vs Queensland match, the suggested target is 271, which is very near the D/L target 271.

It would be perfectly ‘fair’ and practical to make such minor changes. The target set like that would be more scientific because we are using the live match data only, ‘fair’ since the data sample is what the team has itself managed to generate, and more mathematical also, as the batsman’s data is being passed on to the target as it is, the 90n portion is not changing the original data.

## V. CONCLUSION

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We have brought forward a 'single' mechanism, namely the integer partition ' $90n + 30$ ', common to T20 and ODI, naturally operating in cricket. Then, successfully traced the natural congruence present between the batsman's data and the team total score, and developed it into a practical target score formula. Our formula successfully uses the live match data without incorporating the controversial tables and statistical formulas. We have tested our method on many past matches beginning with the 1977s and the current cricket series matches, International ODI, all the International T20, World Cup T20 and ODI matches, domestic t20 series namely IPL, Ram Slam, Big Bash, BPL, even women cricket matches, and found that it successfully generates the correct match score. The D/L method comes under review once every two years, hope the ICC considers our mathematical suggestions, in a serious manner.

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