DLS Module

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➢ Introduction

The **Duckworth-Lewis-Stern method (DLS)** is a mathematical formulation designed to calculate the target score (number of runs needed to win) for the team batting second in a limited overs cricket match interrupted by weather or other. circumstances.

➢ Basic Idea of the DLS method

The D/L method works using the notion that teams have two resources with which to make as many runs as they can - these are the number of overs they have still to receive and the number of wickets they have in hand. From any stage in their innings, their further run-scoring capability depends on both these two resources in combination.

$$Z(u) = Z_0[1 - \exp\{-bu\}].$$

Revised equation:

A revised relationship:
If u overs to go and w wickets in hand, then

$$Z(u, w) = Z_0(w)[1 - \exp\{-b(w)u\}].$$

If 2^{nd} innings resource is more than 1^{st} innings resource then,

If $R_2 > R_1$, then

total score made by team 1.

$$T = S + G(N) \times (R_2 - R_1).$$

- Code Architecture

  First, we need to preprocess the dataset to get the desired data for predicting the runs. So, I function is defined named ***processData()*** which takes original dataset as input and gives output the modified dataset.

  - For 1st question:-
    - **runPrediction(z0,b,u):** It is used to predict the runs on the given value of wicket and overs remaining. This calculates predicted runs for a pair of wickets in hand and overs remaining.
    - **ErrorFunction()-** It takes two parameters initial z0 value and initial b value. It returns total Sum of squared error for each wicket.
    - **DuckworthLewis20Params():-** This function takes preprocessed data and returns 10 parameters each for z0(wicket) and b(wicket). It calls scipy.optimize.brute() function to find optimal **z0** and **b** value.
    - **plotErrorFunc1():-** It takes two parameters which are optimized z0 value and optimized b value. Based on these it plots 10 curves, each plot for predicted runs per wicket and overs left. This plot is resources left vs overs remaining.

  - For 2nd question:-
    - **runPrediction2(z0,L,u,wkt):** It is used to predict the run on the given value of wickets in hand and overs remaining. This function predict runs for a given slope L.
    - **ErrorFunctionForQ2()-** It takes two parameters initial z0 value and initial b value. It returns total Sum of squared error for each wicket.
    - **DuckworthLewis20Params():-** This function takes preprocessed data and returns 10 parameters each for z0(wicket) and b(wicket). It calls scipy.optimize.minimize() function to find optimal **z0** and **L** value. Optimization is done for whole Z0 array at once.
    - **plotErrorFunc1():-** It takes two parameters which are optimized z0 value and optimized L value. Based on these it plots 10 curves, each plot for predicted runs per wicket and overs left. This plot is resources left vs overs remaining.

Results:

- **For Q1:-**

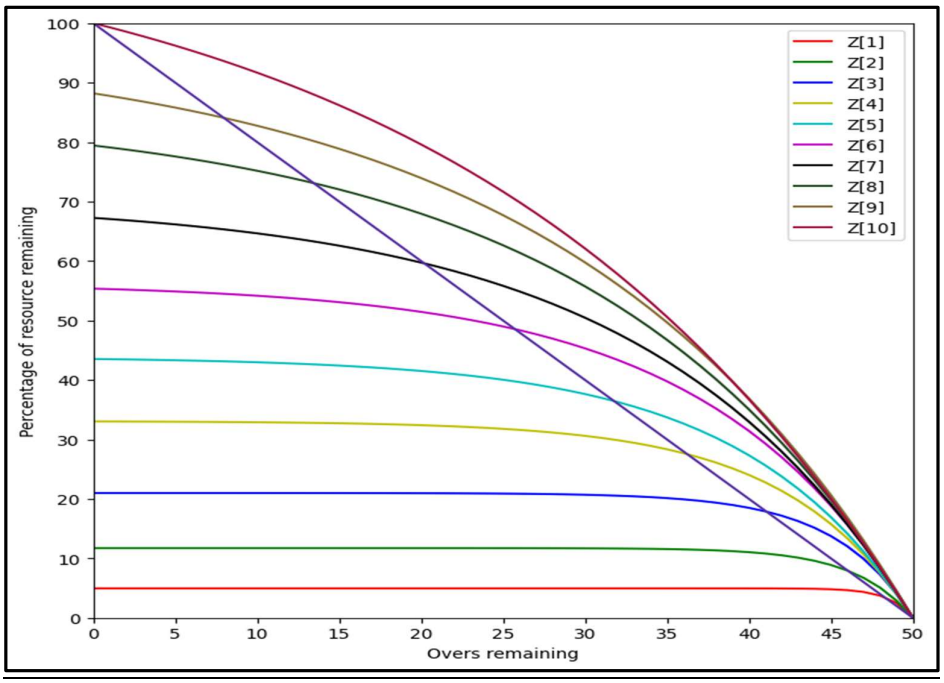
```
-----Error Per point (MSE)--------

1603.151285183614
----------------parameters of 1st function---------
Optimized Z0 value:
[11.98259734575066, 28.365656894325518, 50.77299756177461,
79.99359771461454, 106.08161346841632, 136.19497006690986,
169.79412957107547, 206.99126663859414, 234.88659249254215,
286.68504541609263]

Optimized b value
[0.7013919287813211, 0.28385376408032936, 0.21306301887108936,
0.12970763134723465, 0.09762705683128414, 0.08168178668032774,
0.06346048702373482, 0.05268735550413106, 0.04779013962468638,
0.037122679030775124]
```

- **For Q2:-**

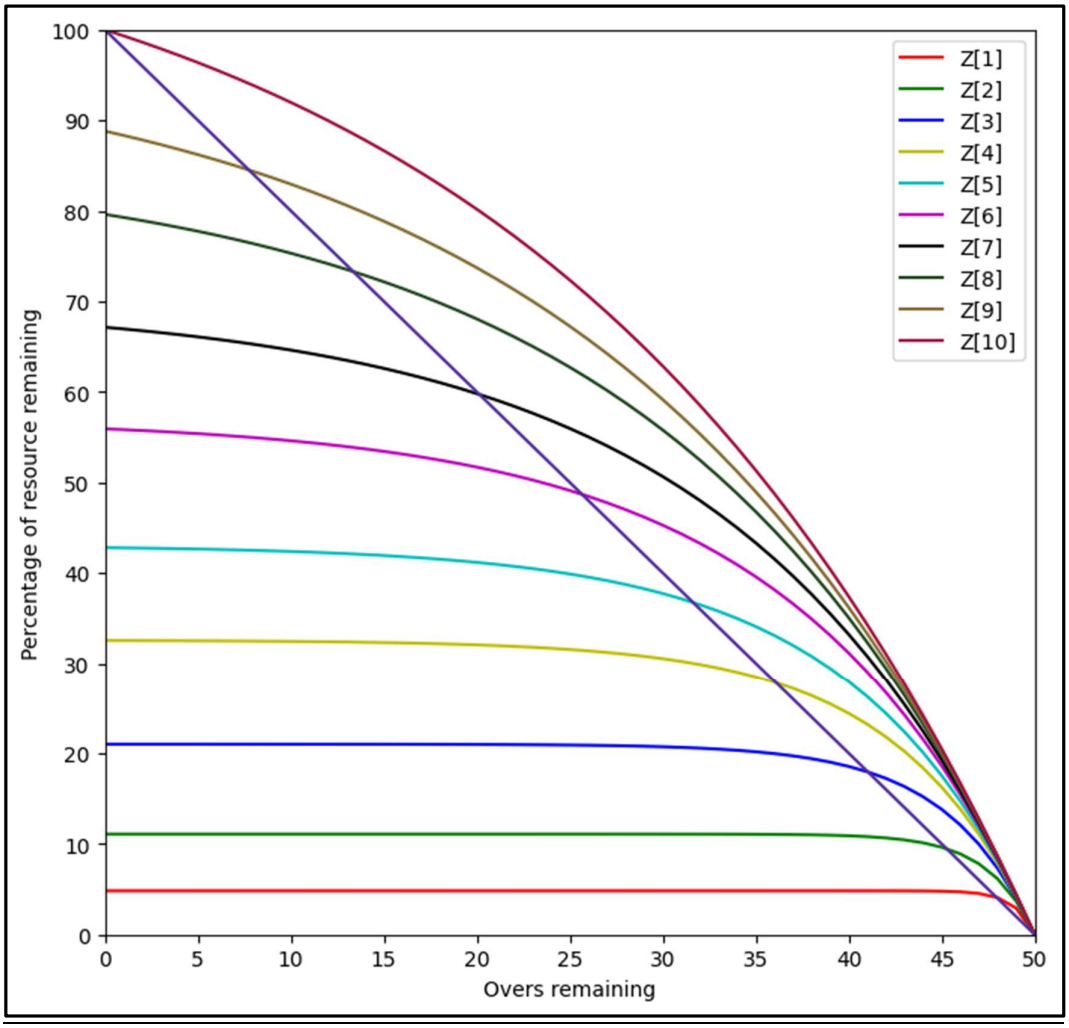
```
-------Error per point for Q2 (MSE)---------

1603.5531522129843
----------------parameters of 2nd function---------
Optimized Z0 value:
[ 11.67747037  26.77701053  50.70936719  78.65371634 103.91014955
 137.69787959 168.88673291 207.28548076 239.01418583 282.83354307]

Optimized L value:
10.879681956590137
```

Plots

- **For Q1:-**



❖ For Q2:-



❖ Conclusion:

Slope values for Q1:-
[8.404497064145994, 8.051698480065443, 10.817848137646157, 10.375780082506214, 10.356435706835397, 11.124648491938954, 10.775218156351583, 10.905822451637993, 11.2252630511854, 10.642516923904797]
Slope value for Q2:- 10.879681956590137

From the equation

$$Z(u) = Z_0[1 - \exp\{-bu\}].$$

If we differentiate this equation with respect to u and equate to 0, we will get slope equal to **b*Zo.**
It is evident that slopes for each plot lies between 8 and 12,spaced very closely to each. Moreover, Average slope for Q1 and slope for Q2 are ∈-equal to each other with ∈ lie between 1 and 2.