Pathuri Sai Harish (SR # 21747)

D/L Method: Run Production Functions

Methodology

The code aims to use the Duckworth-Lewis (D/L) method to compute the resources remaining in a cricket match given the overs-remaining and wickets-in-hand. The code first loads the cricket match data from a CSV file [1] using Pandas. It then applies some cleaning to the data to include only completed games, not interrupted ones. This means the games that were played 50 overs in the first innings or less than 50 overs with 0 wickets remaining are included. The cleaned data contains 59201 rows and is then stored in a separate data frame. The code then defines the D/L model using the parameters Z0 and L (a total of 11 parameters). In the D/L system, the Z0 and L values are estimated through an optimization algorithm that minimizes the normalized sum of squared errors between the predicted and actual runs. The class DLModel contains methods to define the Z-function, compute the error function (normalized per wickets_remaining, overs, and runs), and optimize the error function to obtain the optimal values of Z0s and L. The class DataUtil contains utility methods to extract the match total runs and plot the graphs. The code finally plots two graphs, the average runs obtainable through the D/L method, and the resources remaining through the DL method using the optimal values of Z0s and L.

Results

Experimented with various optimization methods provided by the scipy.optimize.minimize() module [2]. The normalized squared error for each optimization method is as follows:

Optimization Algorithm	Normalized Square Error
BFGS	**4989.93537674943**
L-BFGS-B	4989.939429672349
COBYLA	5077.119336230687
CG	4989.935380690543

Table 1. Optimization Algorithms vs Normalized Square Error

Thus the BFGS is used for getting the optimal Z0s and L.

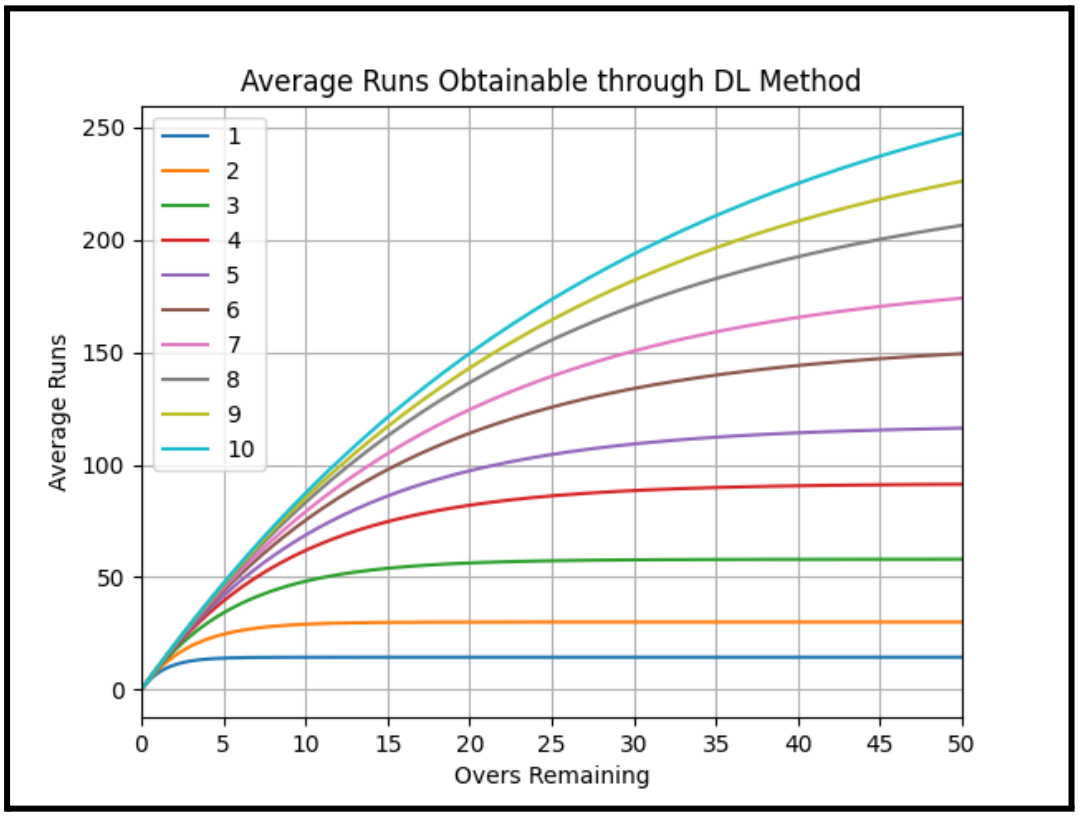
The Z0s for wickets_remaining 1 through 10 are as follows (Trimmed to three decimals):

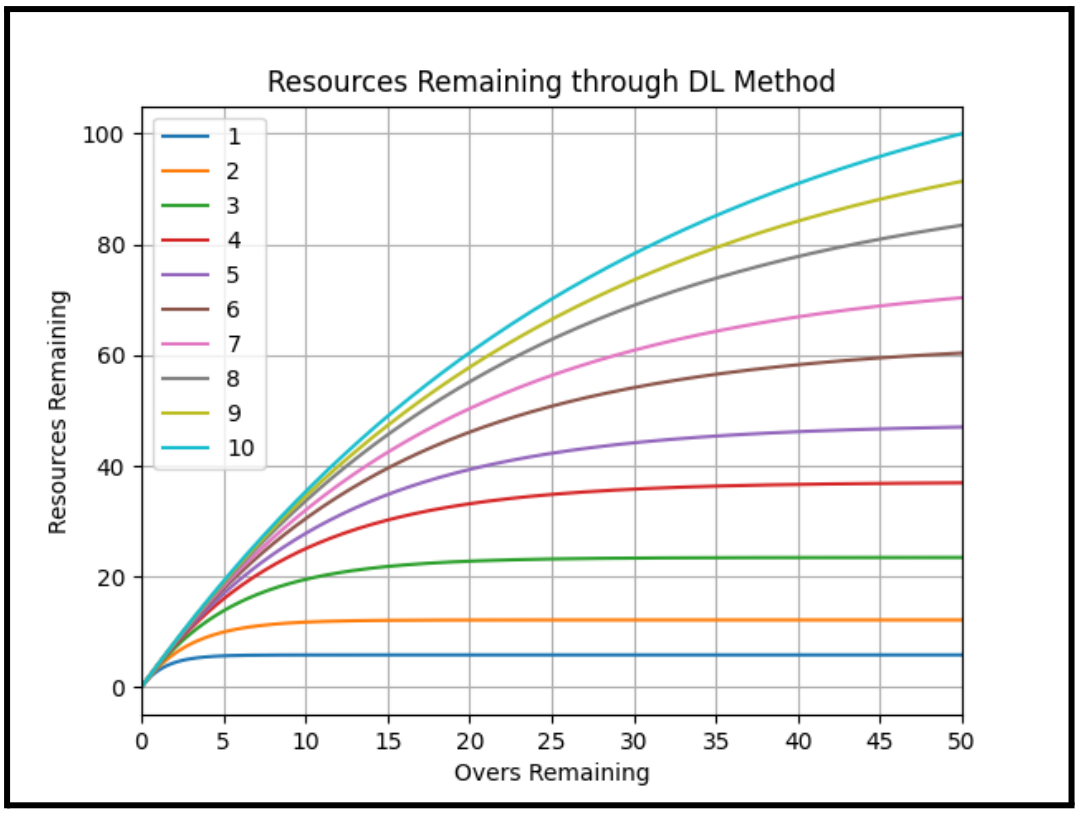
Z0(1)	Z0(2)	Z0(3)	Z0(4)	Z0(5)	Z0(6)	Z0(7)	Z0(8)	Z0(9)	Z0(10)
14.455	30.091	57.992	91.636	117.696	154.848	185.510	231.230	263.012	302.092

Table 2. Z0s for wickets_remaining 1 to 10

The L value is **10.312.**

Below are the plots for the average runs and resources remaining percentage:





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Running Assignment1.py on my system gives the following output:

```
(venv) psh@Sais-Mac-mini code % python -V
Python 3.9.12
(venv) psh@Sais-Mac-mini code % python Assignment1.py
         Match  Runs.Remaining  Wickets.in.Hand  Overs.Remaining  Innings.Total.Runs
6107     64725             359               10               49                 363
6108     64725             351               10               48                 363
6109     64725             347               10               47                 363
6110     64725             330               10               46                 363
6111     64725             320               10               45                 363
...        ...             ...              ...              ...                ...
126339  538070              34                4                4                 262
126340  538070              28                4                3                 262
126341  538070              19                4                2                 262
126342  538070              12                4                1                 262
126343  538070               0                3                0                 262

[59201 rows x 5 columns]
MSE -> BFGS : -> 4989.93537674943
Z0s:
[ 14.45550757  30.09170254  57.99206274  91.63696837 117.69604119
 154.8486824  185.5104063  231.23004987 263.01206007 302.09207632]
L:
10.3127812946512
(venv) psh@Sais-Mac-mini code %
```

References

1. *https://ece.iisc.ac.in/~rajeshs/E0259/04_cricket_1999to2011.csv*
2. *https://docs.scipy.org/doc/scipy/reference/generated/scipy.optimize.minimize.html*