

## OUTLINE

The Duckworth-Lewis (DL) method [1], a ‘fair’ method for deciding a winner of a rain interrupted limited overs cricket match, is an example of how statistics and operational research can be used to improve practice in professional sport. Here, we analyse for the first time how the DL method performs in domestic cricket and examine what it means for a result to be fair.

## A RAIN RULE?



Figure 1: What a cricket match should look like.

In a limited overs cricket match, teams take it in turns to score as many runs from a fixed number of balls, without losing all 10 of their wickets. The batting team have two ‘resources’ available to them, balls to face and wickets to lose. In order to win, each team must optimise the trade-off between batting aggressively and risking losing wickets, or batting conservatively and not making a big enough score. When rain shortens one team’s innings, the number of balls they receive decreases but the number of wickets they have available does not. This upsets the original trade-off, if one team has less time to bat they are happier to be more aggressive and risk losing wickets. Therefore, a method is required to reset the team’s target in a way that maintains the original trade-off.



Figure 2: An all too common occurrence.

## THE DL METHOD

The DL method uses a 2 factor, exponential decay model to calculate the percentage of their original resources a team has remaining when they have lost  $w$  wickets and have  $u$  overs remaining. Then, if the weather intervenes at any point during a game, the winner of the match is the team who scored proportionally the most runs in the resources they received.

## PROFESSIONAL DL & DLS

Following its successful implementation into international cricket, the DL method was updated to Professional DL [3] following further data analysis. In the modern game teams make larger totals more often, and when chasing a large target, teams need to score at a higher rate for more of their innings. This was no longer consistent with Standard DL.

Professional DL introduces a match factor  $\lambda$ , associated with the team batting first scoring a high score. This straightens the DL resource curve for the second innings towards the line indicating constant scoring throughout the innings. This results in a team chasing a high score needing to get a larger proportion of their runs earlier in the innings, than a team chasing an average score.

In light of a further increase in run scoring rates, teams making big scores appeared to score an even larger proportion of their runs early in their innings, but then behaved more like an average team towards the conclusion of their innings. Duckworth-Lewis-Stern (DLS) [2] introduces greater flexibility in how the match factor  $\lambda$  alters the standard DL resource curve.

The DL method is estimated and adapted based on data from international cricket, predominantly using 50 over matches.

## CONCLUSION

- DL correctly captures run scoring patterns in domestic cricket as well as international cricket.
- When a cricket match is defined to be fair, impacts what is incorporated in the definition of fairness.
- Clearer reporting of when a cricket match is considered to be fair and what impacts its fairness, will help to aid DL’s transparency and improve attitudes towards it.

## DL IN COUNTY CRICKET

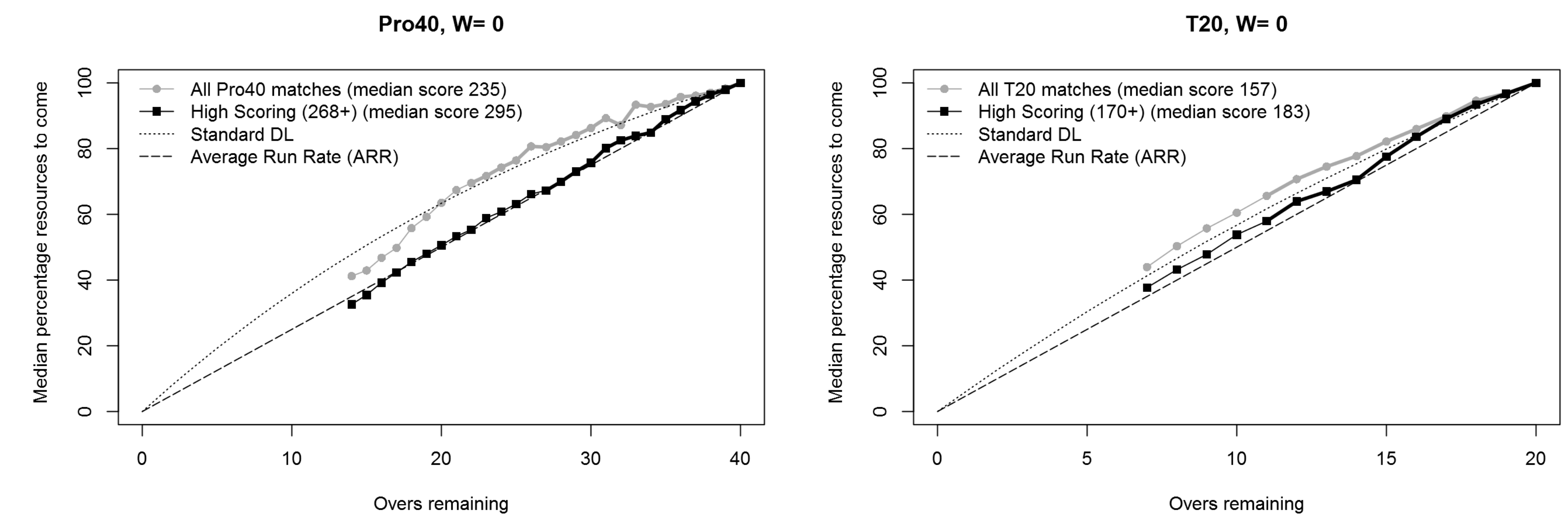


Figure 3: Median runs to come for various resource combinations in 40 and 20 over matches. Bold lines indicate 10 or more games.

Cricket has become more popular through the introduction of shorter formats of the game, namely 40 over (Pro40) and 20 over (T20) in English county cricket. In shorter matches, rain interruptions will tend to have a larger impact on the batting trade-off faced by each team so a fair rain rule is more important. A data set containing 242 T20 and 149 Pro40 matches, with completed first in-

nings were used in Figure 3 to demonstrate:

- Average run scoring patterns are similar across 40 and 20 over domestic cricket.
- They are also consistent with international cricket and Standard DL.
- Teams making large totals score more runs early in their innings and this changes with wickets in a way consistent with Professional DL.

## VALUE JUDGEMENTS

The DL method is designed to be fair. But, how does DL interpret fairness?

- A fair match is one where both teams have to score proportionally the same number of runs in their available resources.
- When and how the resources are determined, defines when and how the fairness of the match is measured. These are value judgements.

The implicit value judgements made by DL are:

- Standard DL: The resources for every section of each innings are defined before the match, in-

dependent of toss deciding who bats or bowls, ground location, teams playing ect. A cricket match is designed to be fair before any of these things are announced or decided upon.

- Professional DL/DLS: Standard DL is no longer fair if the team batting first makes a big score. A Cricket match is now judged to be fair at the end of the first innings.

But the game of cricket is not fair after the toss is made, hence why the toss exists. One example is dew, which makes the ball slippy and hinders the team fielding or bowling last [5] [6].

## REFERENCES

- [1] Duckworth, F and Lewis, A.J. (1998), JORS.
- [2] Stern, S. (2016), JORS.
- [3] Duckworth, F and Lewis, A.J. (2004), JORS.
- [4] Dhoni, M.S. (2013) "Dew made conditions unfair"
- [5] Misbah-ul-Haq, (2016) "Dew hindered spin and reverse swing"