BasketAbyss - An Accurate Rating System for Basketball Competitions

Abyss Li (@StarryAbyss on GitHub)

2 Mar 2024 (Version 1.3.1)

1 Introduction

It's a rating system for basketball competitions. The rating depends on the achievements of a team.

Features

- Accurate;
- Easy to calculate;
- The points in a match had an effect on the ratings, enhance the competitiveness of the players.

2 How It Works

(1) Variables

For each of the matches of a team, we called the variable P_1 = the points the team got in the match, and P_2 = the points the opponents got in the match. The rating before the match of the team is R'_1, of the opponent is R'_2.

(2) Processing of data

We called $D = \dfrac{P_1 - P_2}{P_1 + P_2}$.

In particular,

- if a match is not played, $D = 0$.
- if there is an overtime in the match, $D = \dfrac{\max(\min(P_1 - P_2, 1), -1)}{P_1 + P_2}$.

We divide the matches into three categories based on home and away.

Category	Δ
Home	-0.015
Neither are home	0
Away(Opponents are home)	+0.015

Table 1: Categories

The final value $Df = D + \Delta$.

(3) Main Formula

$R_1 = R'_1 + \max(-0.1I, \min(0.1I, I \times (Df - ExpectedDf)))$

Variables Explanation:

R_1: The rating after the match;

I: The weight of the match;

$ExpectedDf$: Calculated as follows.

$$ExpectedDf = \frac{1}{2^{\frac{R'_2 - R'_1}{600}} + 1} - 0.5$$

Example: Team A's rating is 1200, the opponent Team B's rating is 1000. Then,

Team A: $ExpectedDf = \frac{1}{2^{\frac{1000-1200}{600}} + 1} - 0.5 = 0.0575$

Team B: $ExpectedDf = \frac{1}{2^{\frac{1200-1000}{600}} + 1} - 0.5 = -0.0575$

The constant I is different in different levels of matches.

Level	I	Biggest change($\pm 0.1I$)
Small Friendly Matches	100	± 10
Friendly Matches	150	± 15
Regional Comp. Group	200	± 20
Regional Comp. Tournaments	250	± 25
Continental Comp. Group	300	± 30
Continental Comp. Tournaments	350	± 35
Worldwide Comp. Group	400	± 40
Worldwide Comp. Tournaments	500	± 50

Table 2: Match Levels

Note that in and after the Quarter Finals, the changes wouldn't drop. It will be friendly to the teams which had a high achievement.

(4) Association Managements

Every team in the association has a rating of 1500 points when the team didn't take part in any matches.

The rating will be provisional at first. Some teams will get a higher rating if they took part in fewer matches. So when we calculate the team ranking, think of the beginning ratings as follows:

Number of Matches(After the match)	Base Rating
1	500
2	900
3	1200
4	1400
5	1500

Table 3: Base Ratings

(5) Calculating Period

For leagues, we'd better calculate a new rating in a new season. The final rating R is calculated as follows(depend on a 8-year period):

$R = \dfrac{1 \times R_0 + 0.875 \times R_1 + 0.75 \times R_2 + \cdots + 0.125 \times R_7}{1 + 0.875 + 0.75 + \cdots + 0.125}$

$R_0, R_1, \cdots, R_7$ are the ratings from the the 7-th previous season to the current season.

3 Examples

Team A's rating(R'_1) is 1200, the opponent Team B's rating(R'_2) is 1000. The result of a friendly match which was between them and played in Team A's stadium is 70-60. Then,

(For Team A)

$D = \dfrac{70 - 60}{70 + 60} = 0.0769$

$Df = D + \Delta = 0.0619$

$ExpectedDf = \dfrac{1}{2^{\frac{1000-1200}{600}} + 1} - 0.5 = 0.0575$

$I = 150$

$R_1 = 1200 + \max(-15, \min(15, 150 \times (0.0619 - 0.0575))) = 1200.66$

(For Team B)

$D = \dfrac{60 - 70}{70 + 60} = -0.0769$

$Df = D + \Delta = -0.0619$

$ExpectedDf = \dfrac{1}{2^{\frac{1200-1000}{600}} + 1} - 0.5 = -0.0575$

$I = 150$

$R_2 = 1000 + \max(-15, \min(15, 150 \times (-0.0619 - (-0.0575)))) = 999.34$