

# Basketforces - An Accurate Rating System for Basketball Competitions

Abyss Li (@StarryAbyss on GitHub)

22 Feb 2024 (Version 1.2.1)

## 1 Introduction

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

### **Features**

- Accurate;
- Be easy to calculate;
- Non-provisional;
- 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  $D = \frac{P_1 - P_2}{P_1 + P_2}$ .

In particular, if  $P_1 = P_2 = 0$ , then  $D = 0$ .

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

| Category                 | $\Delta$ |
|--------------------------|----------|
| Home                     | -0.03    |
| Neither are home         | 0        |
| Away(Opponents are home) | +0.03    |

Table 1: Categories

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

Due to the nature of the formula, we don't need to think about whether overtime was played or not.

(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,

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

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

The constant  $I$  is different in different levels of matches.

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

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:

| Match Number(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:

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

$R_0, R_1, \dots, R_7$  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)

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

$$Df = D + \Delta = 0.0469$$

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

$$I = 150$$

$$R_1 = 1200 + \max(-15, \min(15, 150 \times (0.0469 - 0.0575))) = 1198.41$$

(For Team B)

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

$$Df = D + \Delta = -0.0469$$

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

$$I = 150$$

$$R_2 = 1000 + \max(-15, \min(15, 150 \times (-0.0469 - (-0.0575)))) = 1001.59$$