Breakpoint Billiards Rating System (BBRS)

The rating system is an **Elo-derived system** with several enhancements designed to provide fair and accurate player ratings.

Core Formula

1. Initial Rating

All players start at **500** (displayed as Breakpoint Level **5.0**)

2. Expected Win Probability (Elo Formula)

```
Expected = 1 / (1 + 10^((OpponentRating − PlayerRating) / 400))
```

3. K-Factor (Based on Experience Level)

The K-Factor determines how much a player's rating can change. Less experienced players have higher volatility:

Racks Played	K-Factor	Category
Under 100	28	Provisional
100-300	20	Established
Over 300	14	Stable

4. Base Rating Change

```
BaseDelta = K × (ActualOutcome − ExpectedWinProb)
```

Where `ActualOutcome` is **1** for a win, **0** for a loss

5. Opponent Strength Scaling

Players earn more for beating stronger opponents and less for beating weaker ones:

```
Scale = 1 + (RatingDifference / 1000)
```

- Clamped between **0.85** (beating weaker) and **1.15** (beating stronger)

6. Match Modifier (Margin of Victory)

Compares actual rack differential vs expected:

```
Modifier = 1 + ((ActualRackDiff − ExpectedRackDiff) / 20)
```

- Bonus/penalty of up to **±10%** based on performance vs expectations

7. Event Weighting

Event Type	Weight
League	1.0×

Playoffs	1.05×
Tournament	1.08×

Final Calculation

```
RatingChange = BaseDelta × OpponentScaling × MatchModifier × EventWeight
```

Display Conversion

The raw rating is converted to a "Breakpoint Level" for display:

```
BreakpointLevel = floor(rating / 10) / 10
```

A rating of **523** displays as **5.2**

Example: Rating 7.9 vs Rating 5.3

Players

- **Player A**: Breakpoint 7.9 (internal rating: **790**)
- **Player B**: Breakpoint 5.3 (internal rating: **530**)

Assumptions: League match, both players "Established" (K = 20)

Step 1: Expected Win Probability

```
Expected_A = 1 / (1 + 10^((530 − 790) / 400))
           = 1 / (1 + 10^(−0.65))
           = 1 / (1 + 0.224)
           = 0.817 (81.7%)

Expected_B = 1 − 0.817 = 0.183 (18.3%)
```

Player A is heavily favored with an 81.7% win expectation.

Step 2: Opponent Strength Scaling

```
Scale_A = 1 + (530 − 790) / 1000 = 0.74 → capped at 0.85
Scale_B = 1 + (790 − 530) / 1000 = 1.26 → capped at 1.15
```

- Player A gets **lower scaling (0.85)** for beating a weaker opponent
- Player B gets **higher scaling (1.15)** for beating a stronger opponent

---

Scenario 1: Player A (7.9) Wins 7-4

Player A's Rating Change:

```
BaseDelta_A = 20 × (1 − 0.817) = +3.66
Scaled = 3.66 × 0.85 = +3.11
```

```
With match modifier = ~+3 points
```

Result: 790 → 793 (still 7.9)

Player B's Rating Change:

```
BaseDelta_B = 20 × (0 − 0.183) = −3.66
Scaled = −3.66 × 1.15 = −4.21
With match modifier = ~−4 points
```

Result: 530 → 526 (now 5.2)

Scenario 2: Player B (5.3) Upsets and Wins 7-5

Player B's Rating Change:

```
BaseDelta_B = 20 × (1 − 0.183) = +16.34
Scaled = 16.34 × 1.15 = +18.79
With match modifier = ~+21 points
```

Result: 530 → 551 (now **5.5**!)

Player A's Rating Change:

```
BaseDelta_A = 20 × (0 − 0.817) = −16.34
Scaled = −16.34 × 0.85 = −13.89
With match modifier = ~−15 points
```

Result: 790 → 775 (now **7.7**)

Summary Table

Outcome	Player A (7.9)	Player B (5.3)
A wins 7-4 (expected)	+3 pts → 7.9	-4 pts → 5.2
A wins 7-0 (dominant)	+5 pts → 7.9	-6 pts → 5.2
B wins 7-5 (upset!)	-15 pts → 7.7	+21 pts → 5.5
B wins 7-0 (blowout upset!)	-18 pts → 7.7	+25 pts → 5.7

Key Takeaways

1. **Beating weaker opponents = small gains** - Higher-rated players barely move for expected wins
2. **Upsets are rewarding** - Lower-rated players get massive points for beating higher-rated players
3. **Margin of victory matters** - Winning by more than expected adds up to 10% bonus
4. **The system protects higher-rated players** - Losses to strong upsets hurt less (0.85 scaling)
5. **Lower-rated players risk less** - Expected losses cost fewer points (they weren't favored anyway)

Breakpoint Billiards Rating System v1.0