

UCL Elo Ratings & Predictive Modeling (2024/25 Season)

As part of my work in quantitative finance and sports analytics, I developed an Elo rating system to evaluate team performance throughout the 2024/25 UEFA Champions League (UCL) season. Using match-by-match updates, this system dynamically adjusted team ratings based on results, incorporating factors such as opponent strength, Home/Away effects, and final goal difference.

Background and Methodology:

The Elo ranking system was created by Arpad Elo as a method for calculating the relative skill levels of players in zero-sum games, i.e. games where one person's gain is equal to another person's loss. Given the two Elo rankings of two competing players X and Y to be R_x and R_y , the probability of player X winning— P_x —is as follows:

$$P_x = \frac{1}{1 + 10^{\frac{R_y - R_x}{400}}}$$

This year, UEFA introduced a new format for the Champions League group stage. Instead of dividing teams into eight groups of four—where the top two from each group advanced after playing two matches against each opponent—the tournament now features a single 36-team league. Each team plays eight matches against different opponents, with the top eight teams advancing directly to the Round of 16. The next 16 teams compete in a one-off playoff to secure the remaining eight spots.

I was concerned that this new format might not accurately reflect the true strength of the participating teams. Since matchups are not uniform, some teams could face weaker opposition and advance, while others might be eliminated despite playing stronger opponents.

To address this concern, I sought to determine the Elo rankings of each team. By using an objective rating system that adjusts based on match outcomes and opponent strength, I aimed to develop a more accurate measure of team performance throughout the competition. I adapted the Elo system to be applied to the Champions League using the modifications proposed by Bob Runyan¹ as outlined below.

$$R_n = R_0 + P$$
$$P = KG(W - W_e)$$

R_n = the new rating

R_0 = the old rating

P = the point change

K = the weight of each game, set at 60

¹ Lyons, Keith. ["What are the World Football Elo Ratings?"](#). The Conversation. Retrieved 28 January, 2025

$$G = \begin{cases} 1, & \text{if a draw or the goal difference} = 1 \\ \frac{3}{2}, & \text{if the goal difference} = 2 \\ \frac{11 + N}{8}, & \text{if the goal difference} \geq 3 \end{cases}$$

W = the result of the match: 1 if a win, 0.5 if a draw, 0 if a loss

W_e = the expected result of the match, calculated as follows:

$$W_e = \frac{1}{10^{\frac{-dr}{400}} + 1}, dr = R_1 - R_2, \text{ with the home team receiving a } +100 \text{ Elo boost}$$

I used a simple Python script and data sourced from <https://www.football-data.org/> to calculate the individual Elo rankings of each of the 36 teams in the 2024/2025 UCL League system. Thus, the final rankings provide an accurate and objective representation of a team's underlying strength based off its opponent's strength, Home/Away effects, and final goal difference. As I suspected, the league format does not accurately portray the underlying strength of most of the teams: the results are below.

Performance Classification:

To provide additional insight, I also implemented a performance coding system that categorizes teams based on the quality of opposition they earned points against:

Team	ELO	Position (League)	Overrated?
FC Barcelona	2029.19		2 Underperforming
Arsenal FC	2023.39		3 Underperforming
FC Internazionale Milano	2010.25		4 Underperforming
Liverpool FC	1990.43		1 Overperforming
Lille OSC	1987.04		7 Underperforming
Club Atlético de Madrid	1983.09		5 Mildly Overperforming
Bayer 04 Leverkusen	1981.85		6 Mildly Overperforming
Real Madrid CF	1969.16		11 Underperforming
PSV	1969.15		14 Underperforming
Atalanta BC	1966.38		9 Mildly Overperforming
Borussia Dortmund	1963.29		10 Mildly Overperforming
Aston Villa FC	1943.2		8 Overperforming
FC Bayern München	1935.74		12 Mildly Overperforming
Sport Lisboa e Benfica	1930.15		16 Underperforming
Paris Saint-Germain FC	1926.18		15 Performing as Expected
Juventus FC	1920.01		20 Underperforming
AC Milan	1915.88		13 Overperforming
Stade Brestois 29	1905.08		18 Performing as Expected
GNK Dinamo Zagreb	1902.41		25 Underperforming
Club Brugge KV	1900.2		24 Underperforming
Manchester City FC	1898.49		22 Underperforming
Celtic FC	1893.87		21 Mildly Overperforming
Feyenoord Rotterdam	1892.51		19 Overperforming
AS Monaco FC	1880.42		17 Overperforming
Sporting Clube de Portugal	1869.76		23 Overperforming
VfB Stuttgart	1869.15		26 Performing as Expected
Bologna FC 1909	1865.4		28 Underperforming
FK Shakhtar Donetsk	1838.62		27 Mildly Overperforming
SK Sturm Graz	1836.5		30 Underperforming
FK Crvena Zvezda	1815.85		29 Mildly Overperforming
RB Leipzig	1809.56		32 Underperforming
Girona FC	1794.22		33 Underperforming
AC Sparta Praha	1789.02		31 Overperforming
FC Red Bull Salzburg	1749.2		34 Performing as Expected
ŠK Slovan Bratislava	1743.63		35 Performing as Expected
BSC Young Boys	1701.75		36 Performing as Expected

Underperforming – A team that earned most of its points against tough opposition but sits lower in the league than expected.

Performing as Expected – A team whose league position accurately reflects its quality.

Mildly Overperforming – A team that earned some points against weaker opposition, placing slightly higher than expected.

Overperforming – A team that earned most of its points against weaker opposition, ultimately ranking higher in the league table than it should.

Key Insights from the final Matchday 8 rankings:

The final Elo rankings after the League Phase revealed several interesting results:

- **Liverpool (1990.43 Elo) classified as Overperforming:** The Reds secured a higher-than-expected final league ranking due to favorable matchups (i.e. matchups against weak opponents).
- **FC Barcelona (2029.19 Elo) and Arsenal (2023.39 Elo) fell into the Underperforming category,** showing strong underlying ratings but struggling in crucial fixtures; watch out for these teams in the knockout rounds!
- **Manchester City (1898.49 Elo) and Real Madrid (1969.16 Elo) were Performing as Expected,** maintaining consistent performances against varying opposition strengths (losing/drawing to strong teams and beating weaker ones).

Flaws & Limitations:

While Elo ratings provide a solid foundation for evaluating team strength, the model has some inherent limitations:

- **Arbitrary Starting Values** – Every team began with a default 1500 Elo rating, rather than a value derived from prior seasons' performance. This means early-season rankings may not reflect true team strength, as the model lacks historical context.
- **Lack of Player-Level Adjustments** – The model does not account for key injuries, tactical shifts, or squad rotations, which can significantly impact match outcomes.
- **Match Context is Simplified** – While the system adjusts for win/loss margins, it does not integrate expected goals (xG), possession statistics, or other advanced metrics that would be able to enhance predictive accuracy.
- **Home/Away Effects** – The current iteration does not weight home-field advantage separately, treating all matches as neutral contests.

Applications & Future Work:

- This Elo model will serve as the foundation for a **predictive system** aimed at forecasting **knockout-stage outcomes** that I'm working on developing.
- I also plan on ultimately expanding this project to provide machine learning-based predictions for the English Premier League, leveraging a larger dataset in the process to improve accuracy.
- By integrating advanced statistical techniques, I aim to refine the model's predictive power for both pre-match betting strategies and team performance assessments.