The Elo rating system

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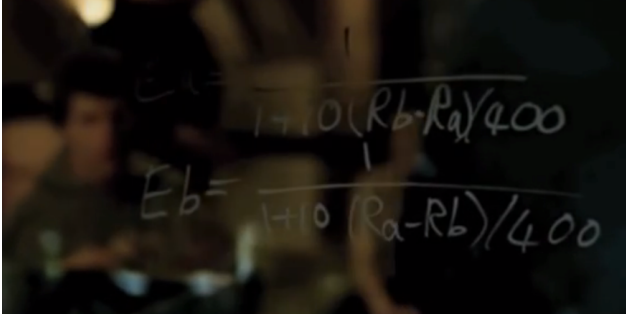**Co-supervisor:** Nicholas R. Moloney (London Mathematical Laboratory)

Figure 1: The Elo rating system, as featured in the film *The Social Network*. A young Mark Zuckerberg in the background fails to point out that the formula is written incorrectly.

Scientific background

The Elo rating system (named after a Hungarian physicist) offers a way of estimating the relative skill of players in head-to-head encounters. Originally, it was developed for chess but has since been applied to various sports and computer games. It not only ranks players, but also predicts how well they would score in future encounters. The player's rating goes up or down according to whether they do better or worse than expected. Assuming that players have some constant intrinsic strength, their ratings should eventually stabilise around particular rating values indicative of that strength.

Research challenge

The goal of the project is to study the performance of the Elo rating system. Monte Carlo simulations of an ensemble of idealised players would provide a convenient framework for posing questions. For example, assuming players do have constant intrinsic strengths, what might a trajectory of a player's rating over time look like? What if the player's intrinsic strength changes over time (e.g. because they improve)?

Real-world data is available from chess tournaments for the past few decades. A question that is often revisited is whether ratings have inflated over the years, with the consequence that players from past eras are underestimated when compared to similarly rated players of today. The student can use Monte Carlo simulations to investigate possible mechanisms of inflation (or even deflation), and then test them against chess data. For example, it is suspected that the way in which new players are given ratings contributes to inflation. Other questions concern the frequency with which ratings are updated, and the 'stepsize' of rating adjustments.

Pre-requisites

Some basic familiarity with Monte Carlo simulations would be helpful. For analysing empirical data, some experience with data manipulation and statistical analysis would be helpful.