Chess Matchmaking Optimization

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(Real variables, constrained.)

Problem Description Chess players are rated using the Elo rating system, which assigns a (non-unique) number to each player based on their level of skill. The problem considered here has to do with optimizing online chess matchmaking, such that players are matched with players of similar skill level.

The decision variable x is the search width the maximum allowable difference in Elo rating between two matched players. N Players are drawn from a distribution of Elo ratings, and arrive (independent of their rating) according to a stationary Poisson process with rate λ. When a player arrives, and there is an existing, unmatched player with Elo rating within x of the first players Elo rating, they are matched. If not, the player waits for an opponent with an appropriate Elo rating to arrive.

The optimization problem is thus to minimize the average Elo difference between all pairs of matched players, such that the average waiting time is $\leq \delta$.

Recommended Parameter Settings: To create the Elo distribution, first generate a normal distribution with mean 1200 and standard deviation $\frac{1200}{\sqrt{2}*\text{erfcinv}(\frac{1}{50})}$, where erfcinv is the inverse complementary error function. This results in a distribution where the 1st percentile is at 0, and 99th percentile is at 2400. Next, truncate the distribution at 0 and 2400.

Let $N = 10000$, $\delta = 5$ minutes and $\lambda = 1$ minute.

Starting Solution(s): Let $x = 150$. If multiple starting solutions are required, first draw x from a normal distributon with mean 150 and standard deviation 50, then set $x = \max(x, 30)$.

Measurement of Time: Number of replications of N generated players.

Optimal Solutions: Unknown.

Known Structure: Unknown.