

POWER RATING OR GOAL MARGIN CALCULATION

Computer ratings for college are based on a margin-of-victory . Consider an example of high school lacrosse. The goal margin of victory equals the difference in power ratings between the two opponents if the game were to be played on a neutral field. When played at the site of one of the teams, a home field advantage (HFA) is added for that team. HFA is determined by averaging the home minus away scores for all games played in the local region.

$$(1) PR1 - PR2 + HFA = score1 - score2$$

Ideally, if you (a) subtract the power ratings of the two teams and (b) account for home field advantage ('+' if the designated team is at home and '-' if the designated team is away), the result should be equal to difference in the actual game score. This will only seldom occur, of course, and each game produces an error as follows:

$$(2) Err-L = (score1 - score2) - HFA - (PR1 - PR2)$$

If $Err-L > 0$, then the designated team played above its computer rating.

Thus, if Team A plays Team B, and Team A has a power rating of 90 and team B has a power rating 80, then A would be predicted to beat B by 10 goals if the game were played at a neutral site. The power ratings are based on all games a team plays and averaged for total performance. The computer program iterates on all teams for all games such that the average error for all teams goes to zero.

All teams start even at the beginning of the season. Past season's performance is not considered. Early in the year, the program has no knowledge of favorites or

underdogs and thus has no bias. However, it takes 5 to 6 weeks for the computations to become meaningful.

The objective of the computer rating scheme is to insure that the iterative final power rating for all teams produces a sum of the local error = 0.00. In other words, the local power rating is the average of a designated team's performance over all games and the magnitude of the '+'s and '-'s balances out as the sum of errors goes to zero when all local games a team plays are considered.

Let's look at an example: Garden City in NY Section 8 for a previous season. Table 1 shows Garden City's schedule with opponent, score, opponent's power rating, and location (home, away or neutral site). The average home field advantage is 1.45 goals and is based on all games played by Section 8 teams.

The error for each game is computed in Table 2. Errors for each game are added to produce Table 3. Graph 1 provides a visual analysis of the results shown in Table 3. Note that the sum of all errors for the local games = 0.0. The sum of all errors for external games is 3.76. The local power rating (first component) is 99.75 and, when the second component is added ($3.76/180.5$) for games outside Section 8, the power rating for Garden City becomes $99.75 + 3.76/180.5 = 99.86$.

Table 1: Schedule

	Opponent	Score	Opp PR	Home
1	Lynbrook	15 6	93.52	away
3	Manhasset	20 8	90.06	away
4	MacArthur	20 5	86.79	home
5	Floral Park	15 0	87.53	away
6	Syosset	21 3	87.38	home
8	Division-Levittown	20 2	82.66	away
9	Carey	24 2	81.37	home
10	Great Neck No	18 3	80.48	away
11	Wantagh	13 10	95.10	home

12	Port Washington	20	6	87.94	away
13	Lawrence	15	7	88.12	away
14	Southside	17	2	85.26	home
15	Long Beach	11	3	87.02	away
16	Southside	18	4	85.26	home
17	Floral Park	17	9	87.53	neut
18	Wantagh	8	10	95.10	neut

Home field advantage = 1.45 goals. Chaminade and Duxbury are non-local games and have been removed from the calculation.

Table 2: Error Analysis

1	Lynbrook	Error = (15- 6) + 1.45 - (99.75 - 93.52) = 4.22
3	Manhasset	Error = (20- 8) + 1.45 - (99.75 - 90.06) = 3.76
4	MacArthur	Error = (20- 5) - 1.45 - (99.75 - 86.79) = 0.59
5	Floral Park	Error = (15- 0) + 1.45 - (99.75 - 87.53) = 4.23
6	Syosset	Error = (21- 3) - 1.45 - (99.75 - 87.38) = 4.18
8	Division-Levittown	Error = (20- 2) + 1.45 - (99.75 - 82.66) = 2.35
9	Carey	Error = (24- 2) - 1.45 - (99.75 - 81.37) = 2.17
10	Great Neck No	Error = (18- 3) + 1.45 - (99.75 - 80.48) = -2.83
11	Wantagh	Error = (13-10) - 1.45 - (99.75 - 95.10) = -3.10
12	Port Washington	Error = (20- 6) + 1.45 - (99.75 - 87.94) = 3.64
13	Lawrence	Error = (15- 7) + 1.45 - (99.75 - 88.12) = -2.18
14	Southside	Error = (17- 2) - 1.45 - (99.75 - 85.26) = -0.94
15	Long Beach	Error = (11- 3) + 1.45 - (99.75 - 87.02) = -3.28
16	Southside	Error = (18- 4) - 1.45 - (99.75 - 85.26) = -1.94
17	Floral Park	Error = (17- 9) + 0.00 - (99.75 - 87.53) = -4.22
18	Wantagh	Error = (8-10) + 0.00 - (99.75 - 95.10) = -6.65

home field = 0.0 means the game was played on a neutral site

point 1 = 99.75 + 4.22 = 103.97

point 2 = 99.75 - 1.40 = 98.35

..... etc.

Table 3: Combined Errors

	Opponent	Score	Opp PR	Home	Err-L	
1	Lynbrook	15	6	93.52	1.45	4.22
3	Manhasset	20	8	90.06	1.45	3.76
4	MacArthur	20	5	86.79	-1.45	0.59
5	Floral Park	15	0	87.53	1.45	4.23
6	Syosset	21	3	87.38	-1.45	4.18
8	Division-Levittown	20	2	82.66	1.45	2.35

9	Carey	24	2	81.37	-1.45	2.17
10	Great Neck No	18	3	80.48	1.45	-2.83
11	Wantagh	13	10	95.10	-1.45	-3.10
12	Port Washington	20	6	87.94	1.45	3.64
13	Lawrence	15	7	88.12	1.45	-2.18
14	Southside	17	2	85.26	-1.45	-0.94
15	Long Beach	11	3	87.02	1.45	-3.28
16	Southside	18	4	85.26	-1.45	-1.94
17	Floral Park	17	9	87.53	0.00	-4.22
18	Wantagh	8	10	95.10	0.00	-6.65

						0.00
	Garden City				99.75

All teams start even at the beginning of the season. Past season's performance is not considered. Early in the year, the program has no knowledge of favorites or underdogs and thus has no bias. However, it takes 5 to 6 weeks for the computations to become meaningful.

The objective of the computer rating scheme is to insure that the iterative final power rating for all teams produces a sum of the local error = 0.00. In other words, the local power rating is the average of a designated team's performance over all games and the magnitude of the '+'s and '-'s balances out as the sum of errors goes to zero when all local games a team plays are considered.

So when scores are fed into the program for analysis, if a team wins 22-7, the score is read in as 17-7. That means that when the program considers this game score, if the actual scores was 18-7, 22-7 or 34-7, they all produce the resulting score of 17-7 and the resulting ratings are the same for these last three scores. We still compute the predicted goal difference and print it on the team page, e.g., 6, 14, 25 goals, but no gain or loss is incurred after 10 goals and no team is punished for not running-up-the-score.

The amount of gain or loss a team will experience is directly related to the difference in power ratings between the two opponents and the goal margin of victory. That is, if two teams play each other and their power ratings differ by 7 goals compared with 2 goals, there is greater potential to move up or down in the former case than the latter. The same holds true for the game score. If the actual goal difference is 8 goals versus 2 goals, more movement in the power ratings will occur in the former than the latter. The greatest opportunity to gain points is to play tougher teams with a higher power rating and if victory is unavoidable, at least limit the goal margin of victory.

Why don't the ratings take into account head-to-head games? They do in so far as a team gets credit for a win versus a loss and possibly an improved rating for goal margins as well as correction points or championship bonus points. However, in most cases it is not enough for one team to overtake another team as it is just one game. The other games on a team's schedule cannot be simply ignored or weighed differently. If one argues that we beat a team therefore we should be rated higher, then apply this rule to every team and any team they lose to should automatically have a higher rating. So in the extreme case, a team that goes 10-1 loses to a team that goes 5-5. The 5-5 team now has a power rating higher than the 10-1 team but wait.

The 5 teams that the 5-5 team lost to have a higher rating than the 5-5 team but the 10-1 team beat most of these teams!

Head-to-head games between two teams is relevant in the power rating calculation only insofar as it effects the four components above. All games a team plays are weighed equally and no games are singled out for special attention. In summary, if head-to-head was considered, how would one treat the situation where team A beats team B who beats team C who beats team A.

Why did our ratings go down when we just beat a team? The movement of the power ratings is dependent on all teams and all games and the impact of other games effects the ratings of teams that have not even played! The strength of opponents is constantly re-evaluated and the game predictions are re-computed with every update. The method that Laxpower uses is described as a "predictor-corrector" which means with every new piece of information (a new game played), all calculations are re-done (iteration) and the results get better (converge). Initially, the ratings fluctuate significantly but as the season winds down, the ratings do not change a whole lot.

How can you rate a team with a weak schedule higher than a team with more difficult Schedule? All power ratings are based on the strength of the opponent, the home-field advantage and the goal margin. If you play a weak schedule and win by large margins, than your ratings will go up. If you play a tough schedule and are defeated by large margins your ratings will go down. The strength of schedule is not treated as an 'explicit' separate component to the formula as is the case with the Ratings Percentage Index (RPI), but rather it is treated as an 'implicit' factor in the goal margin of victory calculation and tied to the actual game score.

Why are the ratings so complicated? If all teams played identical schedules, then ratings would simply be based on won-loss records. However, because all teams play different schedules the problem becomes one of evaluating the strength of opponents so that schedules can be adjusted for degree of difficulty. There is no easy way to do this and you wind up with a tradeoff between a simple to explain and not very accurate algorithm or a very complex algorithm that is difficult to explain.