



GAMBLING II

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UNC STOR 390

RATING SPORTS TEAMS

- Expected Profit of Gambler for Bet on Spread

- Assume $P(\text{Win}) = P(\text{Loss}) = 0.5$

- Expected Profit for Bettor

- $$E[\text{Profit}] = (\$10)(0.5) - (\$11)(0.5) = -\$0.50$$

- Percent of Bets Needed to Win to Break Even

- $$E[\text{Profit}] = (\$10)(p) - (\$11)(1 - p) = 0 \longrightarrow p = 0.524$$

- We Need to Win 52.4% of the Bets on Spread to be Even

- Power Ratings

- Bookmakers Use Ratings to Set Point Spreads

- Example: Panthers +1 and Browns -12

- $$E[\text{Spread}] = 1 - (-12) = 13$$

- This Can Be Adjusted for Home Edges



RATING SPORTS TEAMS

- Spreads from Power Rankings Are Usually “Fair”
- Example of Power Ratings from 2006

Team	Rating	Rank
1 Arizona Cardinals	-6.7842786	29
2 Atlanta Falcons	-3.408071	21
3 Baltimore Ravens	8.3506952	4
4 Buffalo Bills	2.4201424	12
5 Carolina Panthers	-3.059493	20
6 Chicago Bears	8.6780273	3
7 Cincinnati Bengals	3.7895627	7
8 Cleveland Browns	-6.2649554	28

Not Last

- Why Not Use Team Rank for Rating?



RATING SPORTS TEAMS

- Ideal Team Ratings

- Average Team Represented by 0
- Expressed in Units of Points
- Example: Expect Panthers to be 5 Points Better Than Average Team Would Mean Their Rating is +5

- Methodology in 6 Steps

- Step 1: Randomly Attempt to Give Trial Ratings for Each Team and Randomly Establish the Home Edge
- Step 2: Get Actual Game Data
- Step 3: Determine Actual Margin of Victory

$$\text{Margin} = \text{Home Points} - \text{Away Points}$$



RATING SPORTS TEAMS

- Methodology in 6 Steps

- Step 4: Predict Margin From Ratings

$$E[\text{Margin}] = \text{Home Edge} + \text{Home Rating} - \text{Away Rating}$$

- Step 5: Compute Errors from Prediction

$$\text{Error} = \text{Margin} - E[\text{Margin}]$$

								SSE 38306.43
Game #	Home	Away	Home score	Away score	Margin	Prediction	Error	Squared error
1	25	17	28	17	11	3.0440188	7.96	63.29764
2	19	4	19	17	2	9.4576993	-7.5	55.61728
3	21	14	21	26	-5	-6.359264	1.36	1.847599
4	5	2	6	20	-14	1.3013943	-15	234.1327
5	15	9	24	17	7	5.3687521	1.63	2.66097
6	8	20	14	19	-5	-8.089332	3.09	9.543973
7	30	3	0	27	-27	-15.63891	-11	129.0744
8	11	29	6	9	-3	-2.59188	-0.4	0.166562
9	31	22	16	23	-7	-1.831027	-5.2	26.71828
10	12	6	0	16	-26	-11.9336	-14	197.8635
11	26	10	18	10	8	-4.135732	12.1	147.276
12	16	7	10	23	-13	-2.357456	-11	113.2638

Minimize This



RATING SPORTS TEAMS

- Methodology in 6 Steps
 - Step 6: Find Optimal Team Ratings to Minimize SSE
 - EXCEL Solver
 - optim() Function in R

- Alternative: Use Basic Regression

$$\text{Margin} = \beta_0 + X\vec{\beta}$$

Diagram illustrating the components of the regression equation:

- β_0 is labeled **Home Edge**.
- X is the design matrix, shown as:
$$X = \begin{bmatrix} 1 & -1 & \dots & 0 & 0 \\ 0 & -1 & \dots & 1 & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ 1 & 0 & \dots & 0 & -1 \end{bmatrix}$$
 - The first column (all 1s) is labeled **Home**.
 - The last column (all -1s) is labeled **Away**.



RATING SPORTS TEAMS

- **Strength of Schedule**
 - Average the Ability of All Opponents
 - Example from 2006

Team	Mean strength	Rank
1 Arizona Cardinals	-2.09677832	29
2 Atlanta Falcons	-1.15809019	25
3 Baltimore Ravens	-0.47256958	20
4 Buffalo Bills	3.107639211	2
5 Carolina Panthers	-0.87202078	21
6 Chicago Bears	-2.63199544	30
7 Cincinnati Bengals	1.164556765	8
8 Cleveland Browns	1.110025495	9

- **Using Mean Absolute Error**
 - Games With Unusual Spreads Are Outliers
 - Median Minimizes Mean Absolute Error
 - Power Ratings Less Impacted by Outliers



RATING SPORTS TEAMS

- Offensive/Defensive Ratings
 - Related to the Over/Under
 - Offensive Rating = Ability to Score Points
 - Positive = Scores More Points Than Average
 - Negative = Scores Less Points Than Average
 - Defensive Rating = Ability to Stop Scoring
 - Positive = Gives Up More Points Than Average
 - Negative = Gives Up Fewer Points Than Average



RATING SPORTS TEAMS

- **Offensive/Defensive Ratings**

- **Predicted Points Scored by Home Team**

- $$\text{Average} + 0.5(\text{Home Edge}) + \text{Home Off. Rating} + \text{Away Def. Rating}$$

- **Predicted Points Scored by Away Team**

- $$\text{Average} - 0.5(\text{Home Edge}) + \text{Away Off. Rating} + \text{Home Def. Rating}$$

- **Divided Up Home Edge Equally**

- **Average = Average Number of Total Points**

- **Can Be Used to Create Overall Rating**

- $$\text{Team's Off. Rating} - \text{Team's Def. Rating}$$

- **Use These to Predict Team Points**

- **Add Expected Home Points and Expected Away Points to Estimate Over/Under**



RATING SPORTS TEAMS

- Ranking Based on Wins and Losses
 - Controversy in College Football
 - Choosing Top Teams for College Football Playoffs
 - Overall Record
 - Strength of Conference
 - Strength of Out-of-Conference Schedule
 - Head-to-Head Competition
 - Comparative Outcomes of Common Opponents
 - Conference Championships
 - Used to Be Chosen by Computer
 - Now Chosen by Committee
- Problem with Considering Game Scores?



RATING SPORTS TEAMS

- Ranking Based on Wins and Losses
 - Using Team Ratings to Estimate the Probability of Winning
 - Let p Represent the Probability the Home Team Wins
 - Use Logistic Regression to Estimate p

$$p = \frac{e^{\text{home rating} - \text{away rating} + \text{home edge}}}{e^{\text{home rating} - \text{away rating} + \text{home edge}} + 1}$$

- Not Minimizing Least Squares but Maximizing Likelihood
- Home Rating = Impact the Home Team Has on Winning Game
- Away Rating = Impact the Away Team Has on Winning the Game
- Can Be Used to Predict Head-to-Head Games
- Problem Considering Wins/Losses?



RATING SPORTS TEAMS

- Rating Method by Fivethirtyeight
 - Utilizes Elo Rating for Sports
 - Elo Rating Popularized in Chess
 - Judges Teams/Players From Head-to-Head Results
 - Fivethirtyeight Uses Elo Ratings to Forecast Outcomes
 - Elo in NFL
 - Every Team Has a Power Rating
 - Average is 1500
 - Winner Gains Points Equal to the Points Lost by the Loser
 - Formula for Odds of Team Winning

$$P(A) = \frac{1}{10^{-\frac{EloDiff}{400}} + 1}$$



RATING SPORTS TEAMS

- Rating Method by Fivethirtyeight
 - *EloDiff* is Based On a Few Things
 - Difference Between Team Ratings
 - Home Edge Adjustment Scaled by Distance Traveled
 - Rest Adjustment for Teams Coming Off a Bye Week
 - Playoff Adjustment (Favorites Tend to Dominate Underdogs)
 - Quarterback Adjustment (Due to Importance of this Position)
 - Dividing *EloDiff* by 25 Has Been a Good Estimate of Spread
 - Winning Team Gains Points Based on a Few Things
 - K-factor = Regulates How Quickly Ratings Change
 - Forecast Delta = Difference Between The Result and Predicted Probability
 - Margin of Victory Multiplier





FINAL INSPIRATION

When I bet on horses,
I never lose. Why?
I bet on all the horses.

-Tom Haverford