GAMBLING II

Produced by Dr. Mario

UNC STOR 538

RATING SPORTS TEAMS

- Expected Profit of Gambler for Bet on Spread
  - Assume P(Win)=P(Loss)=0.5
  - Expected Profit for Bettor

    $E[Profit] = (\$10)(0.5) - (\$11)(0.5) = -\$0.50$
  - Percent of Bets Needed to Win to Break Even

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

    $E[Spread] = 1 - (-12) = 13$
  - This Can Be Adjusted for Home Edges

RATING SPORTS TEAMS

- Spreads from Power Rankings Are Usually "Fair"
- Example of Power Ratings from 2016

Arizona Cardinals	1.59	13
Atlanta Falcons	8.48	2
Baltimore Ravens	1.54	14
Buffalo Bills	–0.33	21
Carolina Panthers	–1.00	22
Chicago Bears	–7.50	28
Cincinnati Bengals	1.04	16
Cleveland Browns	–10.09	30

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 1 Point Worse Than Average Team Would Mean Their Rating is -1

- 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

$$Margin = Home\ Points\ - Away\ Points$$

RATING SPORTS TEAMS

- Methodology in 6 Steps
  - Step 4: Predict Margin From Ratings

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

  - Step 5: Compute Errors from Prediction

$$Error = Margin - E[Margin]$$

								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

$$Margin = \beta_o + X\vec{\beta}$$

$$X = \begin{bmatrix} 1 & -1 & \cdots & 0 & 0 \\ 0 & -1 & \cdots & 1 & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ 1 & 0 & \cdots & 0 & -1 \end{bmatrix}$$

Home Edge

Home

Away

RATING SPORTS TEAMS

- Strength of Schedule
  - Average the Ability of All Opponents
  - Example from 2016

Team	Rating	Rank	Schedule Strength	Rank
Arizona Cardinals	1.47	15	–1.95	31
Atlanta Falcons	8.59	2	0.08	18
Baltimore Ravens	1.63	13	0.16	16
Buffalo Bills	–0.55	21	–1.66	29
Carolina Panthers	–1.16	23	1.06	6
Chicago Bears	–7.37	28	0.02	19
Cincinnati Bengals	1.06	16	0.43	13
Cleveland Browns	–10.03	30	1.66	2

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

RATING SPORTS TEAMS

- Comparison

Now the Clowns Are Last

Team	MAD Rating	Rank MAD	Least Squares Rating	Least Squares Rank
Arizona Cardinals	–0.64	20	1.59	13
Atlanta Falcons	12.74	1	8.48	2
Baltimore Ravens	0.97	17	1.54	15
Buffalo Bills	–2.98	25	–0.33	21
Carolina Panthers	3.49	10	–1.00	22
Chicago Bears	–8.13	29	–7.50	28
Cincinnati Bengals	–2.51	24	1.04	16
Cleveland Browns	–14.67	32	–10.09	30

- 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

    $Average + 0.5(Home\ Edge) + Home\ Off.Rating + Away\ Def.Rating$
  - Predicted Points Scored by Away Team

    $Average - 0.5(Home\ Edge) + Away\ Off.Rating + Home\ Def.Rating$
  - Divided Up Home Edge Equally
  - Average = Average Number of Total Points
  - Can Be Used to Create Overall Rating

    $Team's\ Off.Rating - Team's\ Def.Rating$
  - 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

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

  - 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

If you don’t remember history,
you won’t know if you repeat it.

-Mahatma Mario