Basketball I

Produced by Dr. Mario

UNC STOR 390

Overview of Basketball

Basketball Statistics

- Information Tracked in Box Score
  - Two-Point Field Goals
  - Three- Point Field Goals
  - Free Throws
  - Personal Fouls
  - Assists
  - Offensive/Defensive Rebounds
  - Blocked Shots
  - Turnovers
  - Steals
  - Minutes Played

Basketball Statistics

- **Classic Measures of Field Goal Percentage**

$$FG\% = \frac{FGM}{FGA} \qquad 3FG\% = \frac{3FGM}{3FGA}$$

FGM = Field Goal Made
FGA = Field Goal Attempt
3FGM = 3-Pointer Made
3FGA = 3-Pointer Attempt

- **Effective Field Goal Percentage (EFG)**
  - **Problem with Previous Metrics**
    - **Knicks: 15/20 Field Goals = 30 Points**
    - **Lakers: 15/20 3-Pt Field Goals = 45 Points**
    - **Same Field Goal Percentage (75%)**
  - **New Metric**

$$EFG\% = \frac{FGM + 0.5 \times 3FGM}{FGA}$$

  - **Adjusted EFG%**
    - **Knicks: 75%**
    - **Lakers: 1125%**

Basketball Statistics

- **Rebounding**
  - **Raw Rebounds is Misleading**
  - **Percentage of Rebounds When on Offense (OREB%)**

$$OREB\% = \frac{OREB}{Missed\ FGA}$$

  - **Percentage of Rebounds When on Defense (DREB%)**

$$DREB\% = \frac{DREB}{Opponent\ Missed\ FGA}$$

REB = Rebound
OREB = Offensive Rebound
DREB = Defensive Rebound
FGA = Field Goal Attempt




Basketball Statistics

- **Free Throws**
  - **Classic Free Throw Percentage (FT%)**

$$FT\% = \frac{FTM}{FTA}$$

  - **Free Throw Rate (FTR)**

$$FTR = \frac{FTA}{FGA}$$

  - **Interpretation: Suppose FTR = 0.39. For Every 100 Shots, the Team is Getting Around 39 Free Throws**

FGA = Field Goal Attempt
FTM = Free Throw Made
FTA = Free Throw Attempt




Basketball Statistics

- Turnovers
  - Possession
    - Starts When Team Gets Ball
    - Ends When Shot Hits Rim or Opponent Gets Ball
    - Average Possessions Per Game Between 90 and 95
  - Turnover Defined
    - Occurs When Team Loses Possession Before Attempting Shot
    - Offense Commits Turnovers and Defense Causes Turnovers
  - Offensive Turnovers Per Possession (TO%)

$$TO\% = \frac{TO\ Committed}{Offensive\ Possessions}$$

  - Defensive Turnovers Per Possession (DTO%)

$$DTO\% = \frac{TO\ Caused}{Defensive\ Possessions}$$

TO = Turnover

Basketball Statistics

- Four Factors For Team Offense
  - EFG%
  - OREB%
  - FTR
  - TO%
- Four Factors For Team Defense
  - Opponent's EFG%
  - DREB%
  - Opponent's FTR
  - DTO%
- Four Factors Credited to Dean Oliver (Denver Nuggets)

Basketball Statistics

- Four Factors are Uncorrelated
  - All Giving Unique Information
  - Highest Correlation
    - Opponent's EFG% and DREB% (-0.67)
    - EFG% and OREB% (-0.47)
    - OREB% and TO%

W = Win

- Importance of 4 Factors in Regression
  - Regression on W

$$W = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_8 X_8 + \epsilon$$

  - Eight Covariates

$X_1 = EFG\%$ $\quad$ $X_5 = Opponent's\ EFG\%$

$X_2 = TO\%$ $\quad$ $X_6 = DTO\%$

$X_3 = OREB\%$ $\quad$ $X_7 = DREB\%$

$X_4 = FTR$ $\quad$ $X_8 = Opponent's\ FTR$

Basketball Statistics

- Regression Results from Justin Jacobs (Squared2020.com)

Estimated Coefficients:

	Estimate	SE	tStat	pValue	
(Intercept)	-107.19	72.077	-1.4871	0.15185	
x1	391.83	43.613	8.9843	1.2211e-08	
x2	-251.29	73.765	-3.4066	0.0026564	
x3	137.08	28.408	4.8254	9.0615e-05	
x4	36.745	39.751	0.92437	0.36579	FTR
x5	-368.68	55.135	-6.6869	1.2843e-06	
x6	331.22	73.675	4.4958	0.00019862	
x7	127.42	56.446	2.2574	0.034757	
x8	-60.952	32.368	-1.8831	0.07361	Opponent's FTR

Number of observations: 30, Error degrees of freedom: 21
Root Mean Squared Error: 3.67
R-squared: 0.922, Adjusted R-Squared 0.892
F-statistic vs. constant model: 31, p-value = 6.03e-10

Linear Weights in Basketball

- **NBA Efficiency Rating (EFF)**
  - Equally Weights Good and Bad Stats
  - Formula

$$EFF = [PTS + REB + AST + STL - TO - (Missed\ FG) - (Missed\ FT)]/G$$

PTS =Point
REB = Rebound
AST = Assist
STL = Steal
TO = Turnover
FG = Field Goal
FT = Free Throw
G = Game

- **Player Efficiency Rating (PER)**
  - Created by John Hollinger (VP of Operations for Memphis)
  - Average Across All NBA Players is 15




Hollinger Stats - Player Efficiency Rating - Qualified Players

RK	PLAYER	GP	MPG	TS%	AST	TO	USG	ORR	DRR	REBR	PER	VA	EWA
1	Giannis Antetokounmpo, MIL	72	32.8	.644	18.9	12.0	32.3	7.3	30.0	19.3	**30.95**	684.4	22.8
2	James Harden, HOU	78	36.8	.616	18.0	11.9	40.8	2.5	17.8	10.0	**30.62**	839.5	28.0
3	Anthony Davis, NO	56	33.0	.597	14.1	7.2	29.4	9.9	27.5	18.8	**30.32**	519.7	17.3
4	Karl-Anthony Towns, MIN	77	33.1	.622	12.9	11.9	28.8	10.9	29.3	20.0	**26.38**	599.6	20.0
	Nikola Jokic, DEN	80	31.3	.589	26.5	11.3	29.4	9.8	27.6	18.7	**26.38**	589.7	19.7

Linear Weights in Basketball

- Player Efficiency Rating (PER)
  - Significant Problems With PER
  - Bad Weights
  - Players With Poor Shooting Percentages Can Increase PER by Attempting More Shots
  - Rewards Bad Shooters
- David Berri
  - Publishes Research Regarding Sports Economics
  - *Wages of Wins Journal*
  - Critical About John Hollinger's PER




Linear Weights in Basketball

- **Win Scores (WS)**
  - **Formula**

$$WS = PTS + REB + STL + 0.5 \times AST + 0.5 \times BLK - \mathrm{FGA} - \mathrm{TO} - 0.5 \times FTA - 0.5 \times PF$$

  - **To Raise WS by Shooting More, Player Needs to Shoot Above 50% for 2-Pointers or Above 33.3% for 3-Pointers**

PTS =Point
REB = Rebound
AST = Assist
STL = Steal
TO = Turnover
BLK = Block
FGA = Field Goal Attempt
FTA = Free Throw Attempt
PF = Personal Fouls

- **Wins Produced (WP)**
  - **Formula for WP Based on WS**
  - **Sum of WP for All Teams Players ≈ Teams Wins**
  - **Cannot Conclude WP Represents Individual Wins**
  - **WP is Not Good for the NBA's Top Defenders**

Linear Weights in Basketball

- Information Not Tracked in Box Score
  - Taking Charges
  - Deflecting a Pass
  - Box Out
  - Assisting the Assister
  - Help Defense
  - Screens

Final Inspiration

If you can’t dunk, lower the hoop.

- Mahatma Mario