

Basketball





Produced by Dr. Mario UNC STOR 390





Overview of Basketball















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











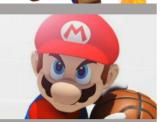
Classic Measures of Field Goal Percentage

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

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%





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

REB = Rebound

OREB = Offensive Rebound

DREB = Defensive Rebound

FGA = Field Goal Attempt









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

Percentage of Rebounds When on Defense (DREB%)

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





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











Turnovers

TO = Turnover

- 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%)

$$TO\% = \frac{TO\ Committed}{Of\ fensive\ Possessions}$$

Defensive Turnovers Per Possession (DTO%)

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













- EFG%
- OREB%
- FTR
- TO%



- Four Factors For Team Defense
 - Opponent's EFG%
 - DREB%
 - Opponent's FTR
 - DTO%









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%



Regression on W

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

W = Win

Eight Covariates

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

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

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

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





















Estimated Coeffic	ients:					
	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		
х3	137.08	28.408	4.8254	9.0615e-05		
x4	36.745	39.751	0.92437	0.36579		
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		

FTR

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





- 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

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Hollinger Stats - Player Efficiency Rating - Qualified Players													
RK	PLAYER	GP	MPG	TS%	<u>AST</u>	<u>TO</u>	<u>USG</u>	ORR	DRR	REBR	PER	<u>VA</u>	<u>EWA</u>
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



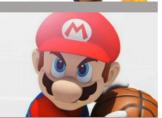
- Player Efficiency Rating (PER)
 - Significant Problems With PER
 - Bad Weights
 - Players With Poor Shooting Percentages Can Increase PER by Attempting More Shots
 - Rewards Bad Shooters



- Publishes Research Regarding Sports Economics
- Wages of Wins Journal
- Critical About John Hollinger's PER













Formula

$$WS = PTS + REB + STL$$

$$+ 0.5 \times AST + 0.5 \times BLK$$

$$- FGA - TO - 0.5 \times FTA - 0.5 \times PF$$

 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

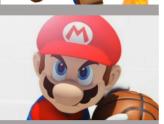
FGA = Field Goal Attempt

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





- 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