

# 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%)

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

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

FTM = Free Throw Made

FTA = Free Throw Attempt













Classic Free Throw Percentage (FT%)

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

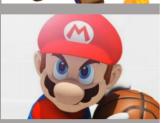
Free Throw Rate (FTR)

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

 Interpretation: Suppose FTR = 0.39. For Every 100 Shots, the Team is Getting Around 37 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

$$W = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \epsilon$$

Four Covariates

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

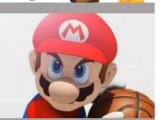
$$X_2 = OREB\% - DREB\%$$

$$X_3 = FTR - Opponent's FTR$$

$$X_4 = TO\% - DTO\%$$









W = Win











- Regression Results
  - High R-Squared and Adjusted R-Squared
  - Importance Based on P-values

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

$$X_4 = TO\% - DTO\%$$

$$X_2 = OREB\% - DREB\%$$

$$X_3 = FTR - Opponent's FTR$$



Not Statistically Significant

Four Factors Credited to Dean Oliver (Denver Nuggets)





- 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%	AST	<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

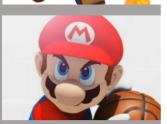
FGA = Field Goal Attempt

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