



Basketball I



Produced by Dr. Mario
UNC STOR 390





Overview of Basketball



Ninh Explains ...

The Rules of **BASKETBALL**

@NinhLyUK www.ninh.co.uk



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

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

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

FTM = Free Throw Made

FTA = Free Throw 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 37 Free Throws**

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





Basketball Statistics

TO = Turnover

- **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%)**

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

- **Defensive Turnovers Per Possession (DTO%)**

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





Basketball Statistics

- Four Factors For Team Offense

- EFG%
- OREB%
- FTR
- TO%



- Four Factors For Team Defense

- Opponent's EFG%
- DREB%
- Opponent's FTR
- DTO%





Basketball Statistics

W = Win

- **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%

- **Importance of 4 Factors in Regression**

- 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**

$$X_1 = EFG\% - \text{Opponent's } EFG\%$$

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

$$X_3 = FTR - \text{Opponent's } FTR$$

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





Basketball Statistics

- Regression Results

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

$$X_1 = EFG\% - \text{Opponent's } EFG\%$$

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

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

$$X_3 = FTR - \text{Opponent's } FTR$$



Not Statistically Significant

- Four Factors Credited to Dean Oliver (Denver Nuggets)





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

1





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**

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

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

- **Wins Produced (WP)**

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

PTS = Point

REB = Rebound

AST = Assist

STL = Steal

TO = Turnover

BLK = Block

FGA = Field Goal Attempt

FTA = Free Throw Attempt

PF = Personal Fouls





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