# Basketball III

Produced by Dr. Mario

UNC STOR 538

# NBA Lineup Analysis

- **Facts About Lineups**
  - Few Players on NBA Teams are Traded
  - Important Coach Decision: Lineups
  - What Players Should Play Together
  - What Players Should Play Against Opponents
  - Approximately 300-600 Unique Lineups in a Season

- **Statistics Measured on the Lineup (NBA.com)**

| LINEUPS | TEAM | GP | MIN | OFFRTG | DEFRTG | NETRTG | AST% | AST/TO | AST RATIO | OREB% | DREB% | REB% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .D. Augustin, .N. Vucevic, .E. Fournier, .A. Gordon, .J. Isaac | ORL | 66 | 852 | 108.4 | 106.0 | 2.4 | 64.4 | 1.94 | 19.4 | 27.8 | 78.5 | 53.2 |
| .R. Rubio, .J. Crowder, .R. Gobert, .J. Ingles, .D. Mitchell | UTA | 60 | 478 | 115.7 | 102.9 | 12.8 | 62.1 | 1.99 | 18.4 | 26.3 | 73.4 | 50.7 |
| .R. Westbrook, .P. George, .S. Adams, .J. Grant, .T. Ferguson | OKC | 58 | 919 | 112.5 | 103.3 | 9.2 | 58.2 | 1.86 | 18.0 | 29.5 | 76.9 | 52.7 |

# NBA Lineup Analysis

- **Statistics Measured on the Lineup (82games.com)**

| # | Team | Unit | Min | Off | Def | Net | W | L | W% |
|---|------|------|-----|-----|-----|-----|---|---|-----|
| 1 | SA | Parker-Jackson-Bowen-Duncan-Robinson | 16.40% | 97.7 | 83.8 | +13.9 | 35 | 15 | 70.0 |
| 2 | DAL | Nash-Finley-Griffin-Nowitzki-Bradley | 6.39% | 100.2 | 88.3 | +11.9 | 16 | 14 | 53.3 |
| 3 | MIN | Hudson-Peeler-Szczerbiak-Garnett-Nesterovic | 14.24% | 105.5 | 94.7 | +10.8 | 23 | 14 | 62.1 |
| 4 | UTA | Stockton-Cheaney-Harpring-Malone-Ostertag | 21.92% | 95.5 | 85.2 | +10.3 | 41 | 23 | 64.0 |
| 5 | SAC | Bibby-Christie-Stojakovic-Webber-Divac | 21.20% | 108.1 | 98.0 | +10.1 | 26 | 11 | 70.2 |
| 6 | TOR | Williams-Carter-Peterson-WilliamsJ-Davis | 7.68% | 99.1 | 89.2 | +10.0 | 14 | 6 | 70.0 |
| 7 | POR | Anderson-Wells-Pippen-Wallace-Davis | 17.15% | 98.8 | 88.9 | +9.8 | 23 | 12 | 65.7 |
| 8 | LAL | Fisher-Bryant-Fox-Horry-O'Neal | 13.57% | 105.6 | 97.1 | +8.6 | 34 | 16 | 68.0 |
| 9 | NO | Davis-Wesley-Mashburn-Brown-Magloire | 18.17% | 97.9 | 89.3 | +8.6 | 24 | 12 | 66.6 |
| 10 | BOS | Delk-Pierce-Williams-Walker-Battie | 12.97% | 95.8 | 89.4 | +6.4 | 23 | 16 | 58.9 |
| 11 | HOU | Francis-Mobley-Posey-Griffin-Ming | 18.03% | 95.9 | 89.7 | +6.2 | 22 | 17 | 56.4 |
| 12 | IND | Tinsley-MillerR-Artest-O'Neal-Miller | 13.77% | 100.2 | 95.6 | +4.6 | 22 | 14 | 61.1 |
| 13 | NJ | Kidd-Kittles-Jefferson-Martin-Collins | 16.17% | 93.1 | 88.6 | +4.6 | 29 | 15 | 65.9 |
| 14 | WAS | Hughes-Stackhouse-Jordan-Laettner-Haywood | 14.98% | 94.6 | 89.9 | +4.6 | 20 | 17 | 54.0 |
| 15 | ATL | Terry-Glover-Robinson-Abdur-Rahim-Ratliff | 16.82% | 97.7 | 93.3 | +4.3 | 27 | 16 | 62.7 |
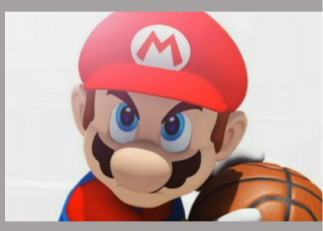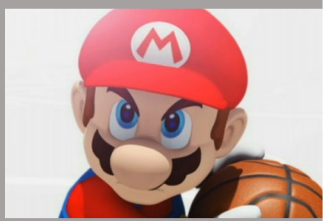
# NBA Lineup Analysis

- **Example: Adjusted +/- for the NBA Lineup**
  - **Warriors 2A={SC,KT,AI,KD,DG} Played 225 Minutes**
  - **This is Equivalent to 4.69 Full Games**
  - **Outscored Opponents by 125 Points (Pure +/-)**
  - **Scaled to 48 Minutes**

$$\frac{125}{4.69} = +26.67 \; Points \; Per \; 48 \; Minutes$$

  - **Lineup Played Against Opposition Lineups Averaging +2.67 Points Better Than Average Team**
  - **Warriors 2A Lineup has Adjusted +/- of 26.67+2.67=+29.67 Points Better Than Average Lineup**
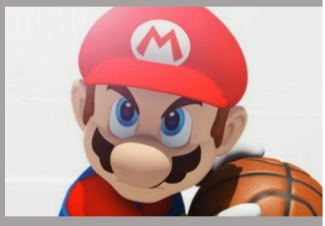
# NBA Lineup Analysis

- **Examples of Poor Lineup Decision Making**
  - Miami Heat (2017-2018)

| # | Unit | Min | Off | Def | +/- | W | L | Win% |
|---|------|-----|-----|-----|-----|---|---|------|
| 1 | Dragic-T.Johnson-Richardson-J.Johnson-Whiteside | 199.7 | 1.06 | 1.05 | -4 | 9 | 16 | 36.0 |
| 2 | Ellington-Richardson-Winslow-Olynyk-Adebayo | 142.6 | 1.15 | 0.93 | +59 | 9 | 5 | 64.2 |

| LINEUPS | TEAM | GP | MIN | OFFRTG | DEFRTG | NETRTG | AST% | AST/TO | AST RATIO | OREB% | DREB% | REB% |
|---------|------|----|----|--------|--------|--------|------|--------|-----------|-------|-------|------|
| .G. Dragic, .J. Johnson, .H. Whiteside, .T. Johnson, .J. Richardson | MIA | 26 | 202 | 101.4 | 101.9 | -0.5 | 58.3 | 1.42 | 16.9 | 27.1 | 77.0 | 52.0 |
| .W. Ellington, .K. Olynyk, .J. Winslow, .J. Richardson, .B. Adebayo | MIA | 16 | 144 | 108.6 | 89.5 | 19.1 | 73.9 | 2.26 | 21.2 | 28.9 | 81.3 | 55.2 |

  - **Which Lineup Should Play More?**

# NBA Lineup Analysis

- **Problem's With Lineup Analysis**
  - **Many Lineups Don't Play Many Minutes (High Variability)**
  - **Less Than 10% of All Lineups Have More than 27 Offensive Possessions**
  - **Median Number of Possessions Across All Lineups = 6 Possessions**
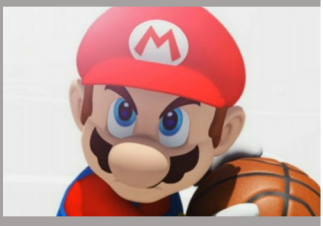
- **Superiority Hypothesis Testing**
  - **Null Hypothesis: Lineups are Equal**
  - **Alternative Hypothesis: Lineup 1 is Superior to Lineup 2**
  - **P-Value < 0.05: Indicates Lineup 1 Superior to Lineup 2**
  - **Estimate of Lineup's Ability Above Average Team = Adjusted +/-**
  - **Standard Error of Estimate**

$$\sigma = \frac{12}{\sqrt{Number\ of\ Games}}$$

Needs Justification

# NBA Lineup Analysis

- **Example: Competing Cavs Lineups (2016-2017)**
  - Lineup 1 With Bazemore: Adjusted +/- of -2.4
  - Lineup 2 With Tim Hardaway Jr.: Adjusted +/- of 28
  - Lineup 1 Played 426 Minutes or 8.875 Games
  - Lineup 2 Played 126 Minutes or 2.625 Games
  - Question: Was Lineup 2 Significantly Better than Lineup 1?

| Howard, Schroder, Millsap, Sefelosha | | | | |
|---|---|---|---|---|
| | | | | |
| 5th | Lineup | Rating | Minutes | Games |
| Bazemore | 1 | −2.4 | 426 | 8.875 |
| Hardaway Jr. | 2 | 28 | 126 | 2.625 |
| | | | | |
| | | | Probability Lineup 2 is better | |
| Difference | Variance difference | Sigma difference | | |
| −30.4 | 71.082495 | 8.431043528 | 0.9999289 | |

$$\hat{\sigma}^2 = \frac{144}{8.875} + \frac{144}{2.625}$$

$$p - value = pnorm(-30.4, mean = 0, sd = 8.43)$$
$$= 0.0002$$

# NBA Lineup Analysis

- **Lineup Chemistry**
  - **How Would You Define Good Chemistry?**
  - **Let LAPM Represent Lineup Adjusted +/- Rating**
  - **Let PAPM Represent Player Adjusted +/- Rating**

$$Chemistry = LAPM - \sum_{i=1}^{5} PAPM_i$$

- **Example (2016-2017):**

| Team | Player 1 | Player 2 | Player 3 | Player 4 | Player 5 | Minutes | Chemistry |
|------|----------|----------|----------|----------|----------|---------|-----------|
| ATL | Hardaway | Howard | Millsap | Schroeder | Sefelosha | 120 | 27 |
| BOS | Bradley | Crowder | Smart | Thomas | Olynyk | 114 | −14 |
| CHI | Butler | Gibson | Grant | Lopez | Wade | 133 | 16 |
| CLE | Smith | James | Frye | Love | Irving | 83 | 18 |
| GSW | Stephen Curry | Green | Iguodola | Mcgee | Thompson | 94 | −11 |
| DAL | Seth Curry | Barnes | Harris | Matthews | Mejri | 57 | −14 |
| HOU | Beverly | Dekker | Gordon | Capella | Brewer | 91 | −15 |
| LAC | Crawford | Griffin | Jordan | Paul | Mbah_a_Moute | 80 | 19 |
| LAL | Ingram | Mozgov | Randle | Russell | Young | 63 | −23 |

# Team and Individual Matchups

- **Example of Coaching Decision**
  - Spurs Versus Mavericks in 2006 Playoffs
  - Mavericks Beat Spurs in 7 Games
  - Replaced Adrian Griffin with Devin Harris
  - Mavericks' Season Information

| Player | Min | Production | | | On Court/Off Court | | |
|---|---|---|---|---|---|---|---|
| | | Own | Opp | Net | On | Off | Net |
| Nowitzki | 78% | 30.1 | 17.0 | +13.1 | +7.9 | -0.6 | +8.5 |
| Terry | 70% | 19.7 | 14.8 | +4.9 | +8.1 | +0.9 | +7.2 |
| Howard | 48% | 20.8 | 13.2 | +7.6 | +7.9 | +4.2 | +3.6 |
| Stackhouse | 38% | 15.6 | 13.1 | +2.5 | +4.5 | +6.9 | -2.5 |
| Daniels | 44% | 15.9 | 12.9 | +3.0 | +4.4 | +7.3 | -2.9 |
| Dampier | 49% | 14.8 | 16.2 | -1.4 | +5.9 | +6.1 | -0.2 |
| Harris | 32% | 18.6 | 15.4 | +3.2 | +6.3 | +5.8 | +0.5 |
| Diop | 38% | 12.2 | 16.5 | -4.3 | +7.7 | +4.9 | +2.7 |
| Griffin | 31% | 12.4 | 14.6 | -2.2 | +7.1 | +5.5 | +1.6 |
| Van Horn | 27% | 14.9 | 18.7 | -3.8 | +4.1 | +6.7 | -2.5 |
| Armstrong | 16% | 7.9 | 19.9 | -12.0 | -1.0 | +7.3 | -8.3 |

# Team and Individual Matchups

- **Example of Coaching Decision**
  - Mavericks' Playoff Information

| Player | Min | Production | | | On Court/Off Court | | |
|---|---|---|---|---|---|---|---|
| | | Own | Opp | Net | On | Off | Net |
| Nowitzki | 87% | 28.5 | 13.8 | +14.8 | +5.3 | -4.8 | +10.1 |
| Howard | 73% | 17.5 | 12.4 | +5.1 | +7.2 | -4.6 | +11.8 |
| Terry | 75% | 17.3 | 13.2 | +4.1 | +5.2 | +0.5 | +4.7 |
| Stackhouse | 63% | 13.6 | 11.8 | +1.8 | +5.5 | +1.5 | +4.0 |
| Griffin | 31% | 13.7 | 16.4 | -2.7 | +3.2 | +4.4 | -1.2 |
| Dampier | 40% | 14.1 | 24.4 | -10.2 | +6.8 | +2.2 | +4.6 |
| Harris | 50% | 12.4 | 16.6 | -4.2 | +0.8 | +7.2 | -6.4 |
| Daniels | 20% | 12.3 | 18.4 | -6.1 | +1.7 | +4.6 | -2.8 |
| Diop | 36% | 12.0 | 19.0 | -7.0 | +1.4 | +5.5 | -4.1 |
| Van Horn | 15% | 6.6 | 16.8 | -10.1 | -12.8 | +7.1 | -19.9 |
| Powell | 2% | -8.2 | 12.4 | -20.7 | -3.9 | +4.2 | -8.1 |
| Mbenga | 2% | -1.1 | 23.6 | -24.7 | +13.5 | +3.8 | +9.7 |
| Armstrong | 4% | 2.4 | 38.4 | -36.0 | -8.3 | +4.5 | -12.9 |

# Team and Individual Matchups

- **Example of Coaching Decision**
  - **Why Was This a Good Decision?**

| Statistics for Harris | Overall Season | Against Spurs |
|---|---|---|
| Adjusted +/- (WINVAL) | -2.1 | +9.4 |
| Impact Rating | -15% | +8% |

| Statistics for Griffin | Overall Season | Against Spurs |
|---|---|---|
| Adjusted +/- (WINVAL) | NA | -5.0 |
| Impact Rating | NA | -18% |

- **Adrian Griffin Had a -18 Offensive WINVAL Which Means He Had a -13 Defensive WINVAL (Horrible Impact on the Mavericks' Offense)**

# Team and Individual Matchups

- **2-Way Lineup Calculator**
  - Summarizes Result of Any Combination of Team's Players On or Off the Court Versus Any Combination of Opponent's Players On or Off the Court
  - Calculation For Mavericks and Spurs Indicated Devin Harris Could Outperform Tony Parker

- **Result in Spurs and Mavericks Playoff Series**
  - Harris and Parker On Court = 2 Points Over Spurs
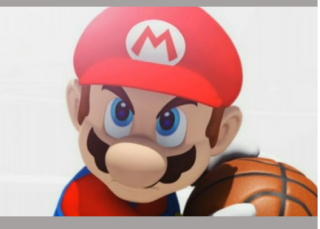  - Harris Off Court and Parker On Court = 15 Points Under Spurs

# Team and Individual Matchups

- Lineup Calculation for the Mavericks in Playoffs

| | | | | | | Rating | Minutes | Simple | Raw +/− |
|---|---|---|---|---|---|---|---|---|---|
| *Dallas Mavericks* | | | | | | | | | |
| 1 | Diop | Harris | Howard | Nowitzki | Terry | 16.36 | 41.04 | 1.18 | 1 |
| 2 | Dampier | Howard | Nowitzki | Stackhouse | Terry | 29.24 | 31.06 | 15.45 | 10 |
| 3 | Dampier | Harris | Nowitzki | Stackhouse | Terry | 60.55 | 21.34 | 49.47 | 22 |
| 4 | Dampier | Harris | Howard | Nowitzki | Terry | −1.78 | 15.89 | −18.12 | −6 |
| 5 | Dampier | Harris | Howard | Nowitzki | Stackhouse | −20.83 | 14.19 | −33.80 | −10 |
| 6 | Diop | Harris | Nowitzki | Stackhouse | Terry | 15.54 | 11.48 | 4.18 | 1 |
| 7 | Dampier | Daniels | Howard | Stackhouse | Terry | −65.28 | 8.92 | −75.26 | −14 |
| 8 | Diop | Howard | Nowitzki | Stackhouse | Terry | −26.13 | 8.79 | −43.62 | −8 |
| 9 | Diop | Harris | Howard | Nowitzki | Stackhouse | 81.91 | 8.02 | 65.92 | 11 |
| 10 | Daniels | Harris | Howard | Nowitzki | Stackhouse | 78.79 | 7.82 | 67.55 | 11 |
| 11 | Diop | Howard | Nowitzki | Terry | Griffin | −9.51 | 6.92 | −34.70 | −5 |
| 12 | Harris | Howard | Nowitzki | Stackhouse | Terry | 44.11 | 6.78 | 35.43 | 5 |
| 13 | Dampier | Daniels | Nowitzki | Stackhouse | Terry | −42.30 | 6.37 | −52.81 | −7 |

# Team and Individual Matchups

- Lineup Calculation for the Mavericks in Playoffs

| | | | | | | Rating | Minutes | Simple | Raw +/− |
|---|---|---|---|---|---|---|---|---|---|
| **San Antonio Spurs** | | | | | | | | | |
| 1 | Bowen | Duncan | Finley | Ginobili | Parker | 21.08 | 45.83 | 6.29 | 6 |
| 2 | Barry | Bowen | Duncan | Finley | Parker | 37.90 | 33.42 | 20.12 | 14 |
| 3 | Bowen | Duncan | Ginobili | Horry | Parker | 17.94 | 28.23 | 5.10 | 3 |
| 4 | Barry | Bowen | Duncan | Horry | Parker | −26.88 | 10.05 | −47.75 | −10 |
| 5 | Barry | Duncan | Finley | Ginobili | Parker | 71.11 | 9.52 | 60.37 | 12 |
| 6 | Barry | Bowen | Duncan | Ginobili | Parker | −25.71 | 8.48 | −45.28 | −8 |
| 7 | Barry | Duncan | Finley | Ginobili | Van Exel | 46.74 | 7.70 | 37.35 | 6 |
| 8 | Bowen | Duncan | Finley | Ginobili | Van Exel | 32.55 | 7.67 | 18.79 | 3 |
| 9 | Duncan | Finley | Ginobili | Horry | Van Exel | −22.46 | 5.84 | −24.68 | −3 |
| 10 | Barry | Bowen | Duncan | Finley | Van Exel | −53.95 | 5.66 | −59.24 | −7 |
| 11 | Barry | Finley | Ginobili | Horry | Parker | −14.32 | 5.53 | −26.06 | −3 |
| 12 | Bowen | Duncan | Ginobili | Horry | Van Exel | 46.51 | 4.13 | 34.84 | 3 |
| 13 | Barry | Bowen | Finley | Horry | Parker | −179.83 | 4.11 | −186.96 | −16 |
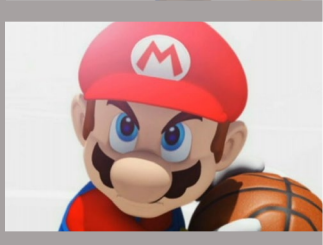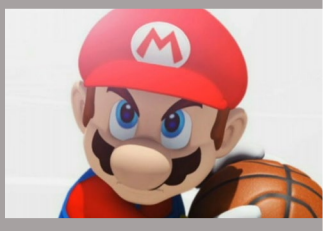
# Team and Individual Matchups

- **Non-Transitivity of NBA Matchups**
  - **What is Transitivity?**
    - Player A > Player B
    - Player B > Player C
    - Then, Player A > Player C
  - **Be Careful Not To Assume Transitive Property in Sports**
  - **Example in 2005-2006 Season**
    - Devin Harris > Tony Parker
    - Devin Harris + Jason Terry Against Steve Nash (-23 Points)
    - Jerry Stackhouse + Jason Terry Against Steve Nash (+20 Points)
    - Steve Nash > Devin Harris
    - Does This Imply, Steve Nash > Tony Parker
    - Across Season, Steve Nash Impact was +28%
    - Against Spurs, Steve Nash Impact was 0%
    - Across Season, Tony Parker Impact was -3%
    - Against Suns, Tony Parker Impact was +35%
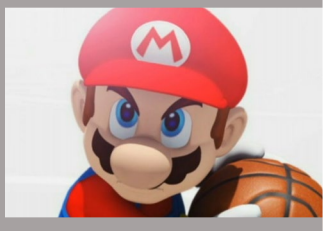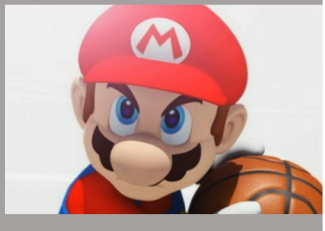
# Final Inspiration

If you are going to foul, foul hard.

- My Father