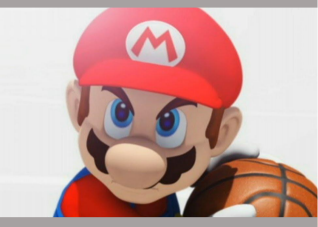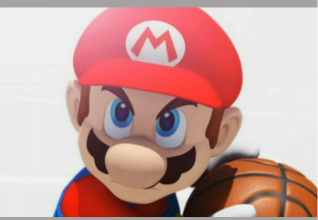# Basketball III

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
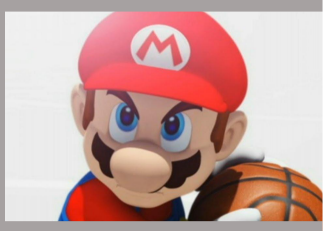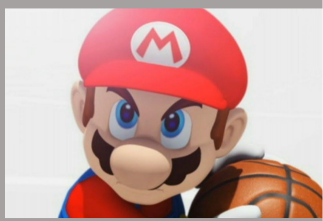
NBA Lineup Analysis

- **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 (Raw +/-)**
  - **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**
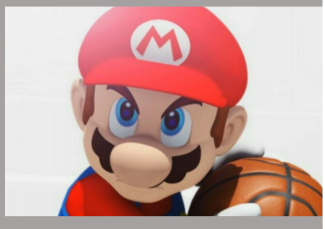
NBA Lineup Analysis

- **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

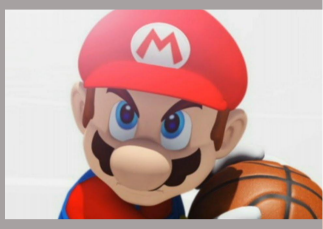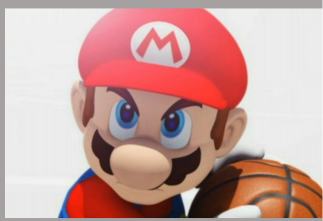- **Which Lineup Should Play More?**
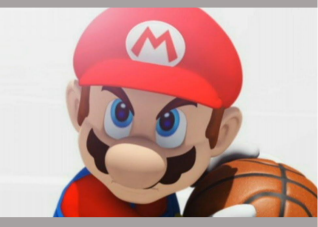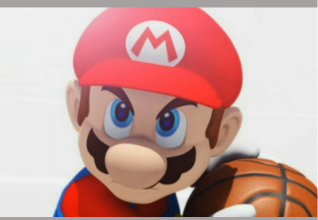
NBA Lineup Analysis

- **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

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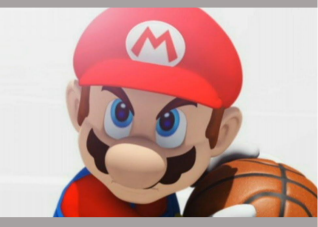
Needs Justification

NBA Lineup Analysis

- **Example: Competing Hawks 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
Difference	Variance difference	Sigma difference	Probability Lineup 2 is better	
−30.4	71.082495	8.431043528	0.9999289	

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

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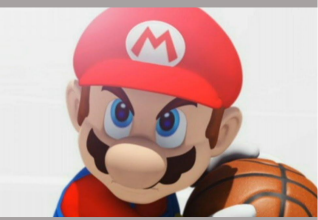
NBA Lineup Analysis

- **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
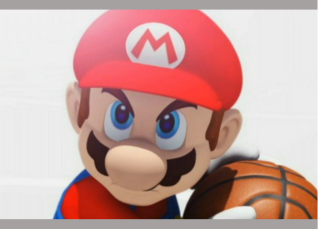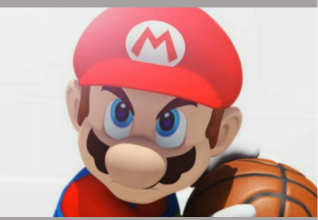
Team and Individual Matchups

- **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
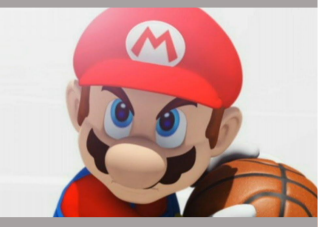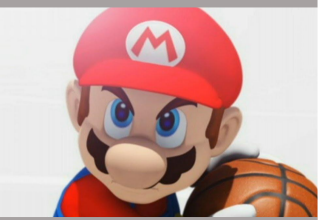
Player	Min	Production			On Court/Off Court		
		Own	Opp	Net	On	Off	Net
Nowitzki	78%	30.1	17.0	+13.1	+7.9	-0.6	+8.5
Terry	70%	19.7	14.8	+4.9	+8.1	+0.9	+7.2
Howard	48%	20.8	13.2	+7.6	+7.9	+4.2	+3.6
Stackhouse	38%	15.6	13.1	+2.5	+4.5	+6.9	-2.5
Daniels	44%	15.9	12.9	+3.0	+4.4	+7.3	-2.9
Dampier	49%	14.8	16.2	-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

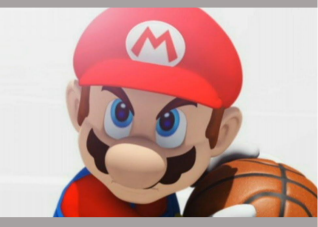| Player	Min	Production			On Court/Off Court		
		Own	Opp	Net	On	Off	Net
Nowitzki	87%	28.5	13.8	+14.8	+5.3	-4.8	+10.1
Howard	73%	17.5	12.4	+5.1	+7.2	-4.6	+11.8
Terry	75%	17.3	13.2	+4.1	+5.2	+0.5	+4.7
Stackhouse	63%	13.6	11.8	+1.8	+5.5	+1.5	+4.0
Griffin	31%	13.7	16.4	-2.7	+3.2	+4.4	-1.2
Dampier	40%	14.1	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
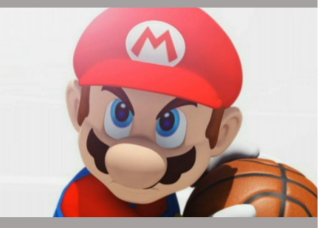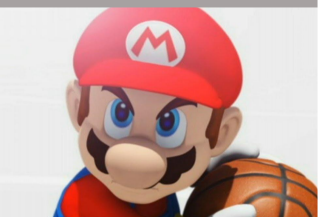
Team and Individual Matchups

- **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%

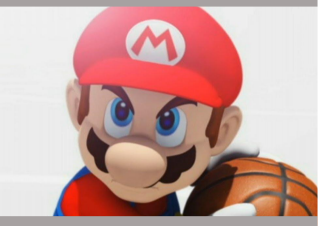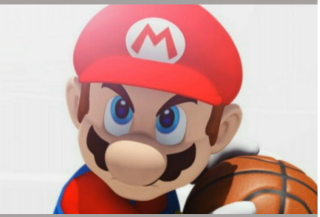| Statistics for Griffin	Overall Season	Against Spurs
Adjusted +/- (WINVAL)	NA	-5.0
Impact Rating	NA	-18%

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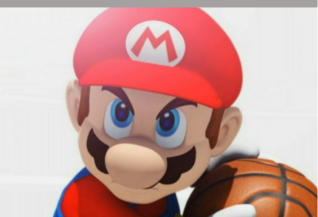
Team and Individual Matchups

- ## 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

- **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
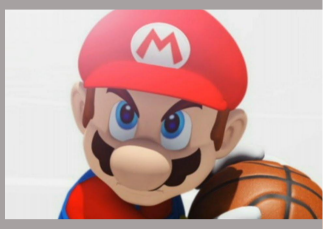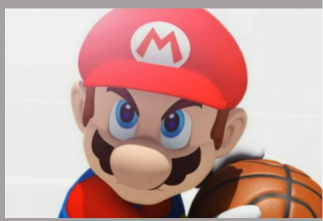
Team and Individual Matchups

- 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
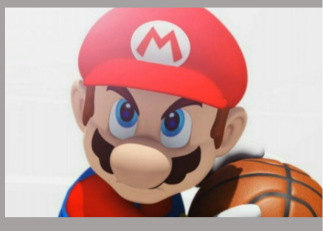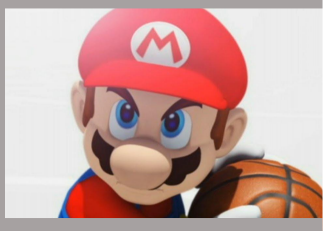
Team and Individual Matchups

- **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%
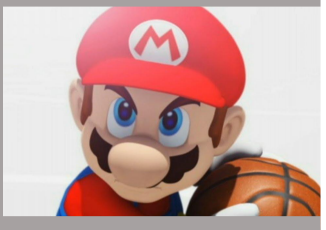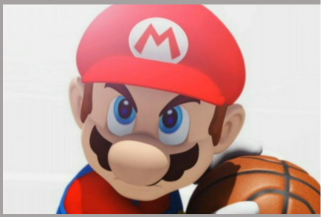
Final Inspiration

If you are going to foul, foul hard.

- My Father