



# Basketball VI



Produced by Dr. Mario  
UNC STOR 538





# End-Game Strategy

- Focus on Two End-Game Situations

- Situation 1

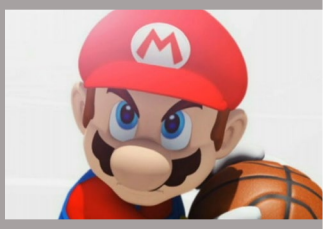
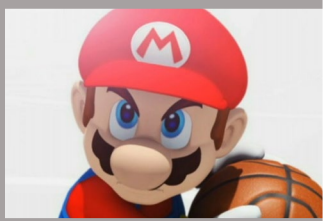
- Your Team Has the Ball With 5 Seconds Left and Losing by 2 Points
    - Should You Attempt 2-Point Shot to Tie or 3-Point Shot to Win?
    - Example: Philadelphia Versus Indiana in 2001 Playoffs (Game 1)

- Situation 2

- Your Team is Defending With 5 Seconds Left and Winning by 3 Points
    - Should You Foul or Allow Opponent to Attempt a 3-Pointer for the Tie?
    - Example: Dallas Versus Phoenix in 2005 Playoffs (Game 6)

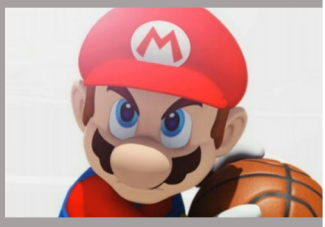
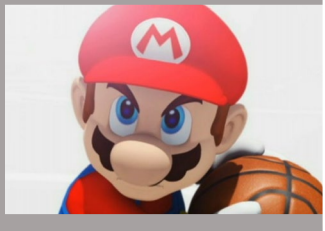
- Actual Outcomes

- Situation 1: Reggie Miller Won Game with 3-Pointer at Buzzer to Win
  - Situation 2: Steve Nash Tied the Game with 3-Pointer and Later Won the Game after a Double Overtime





# End-Game Strategy



- **Decision Making for Situation 1**

- Goal: Make Decision that Maximizes Probability of Winning
- Two Assumptions
  - Other Team Will Not Foul on Shot
  - Game Will End on Our Shot

- **Important Events**

- A = Event that a 2-Pointer is Good
- B = Event that a 3-Pointer is Good
- C = Event that We Win in Overtime
- W = Event We Win the Game
- L = Event We Lose the Game

- **Probabilities Based on Data Over Many Seasons**

$$P(A) = 0.45$$

$$P(B) = 0.33$$

$$P(C) \approx 0.5$$

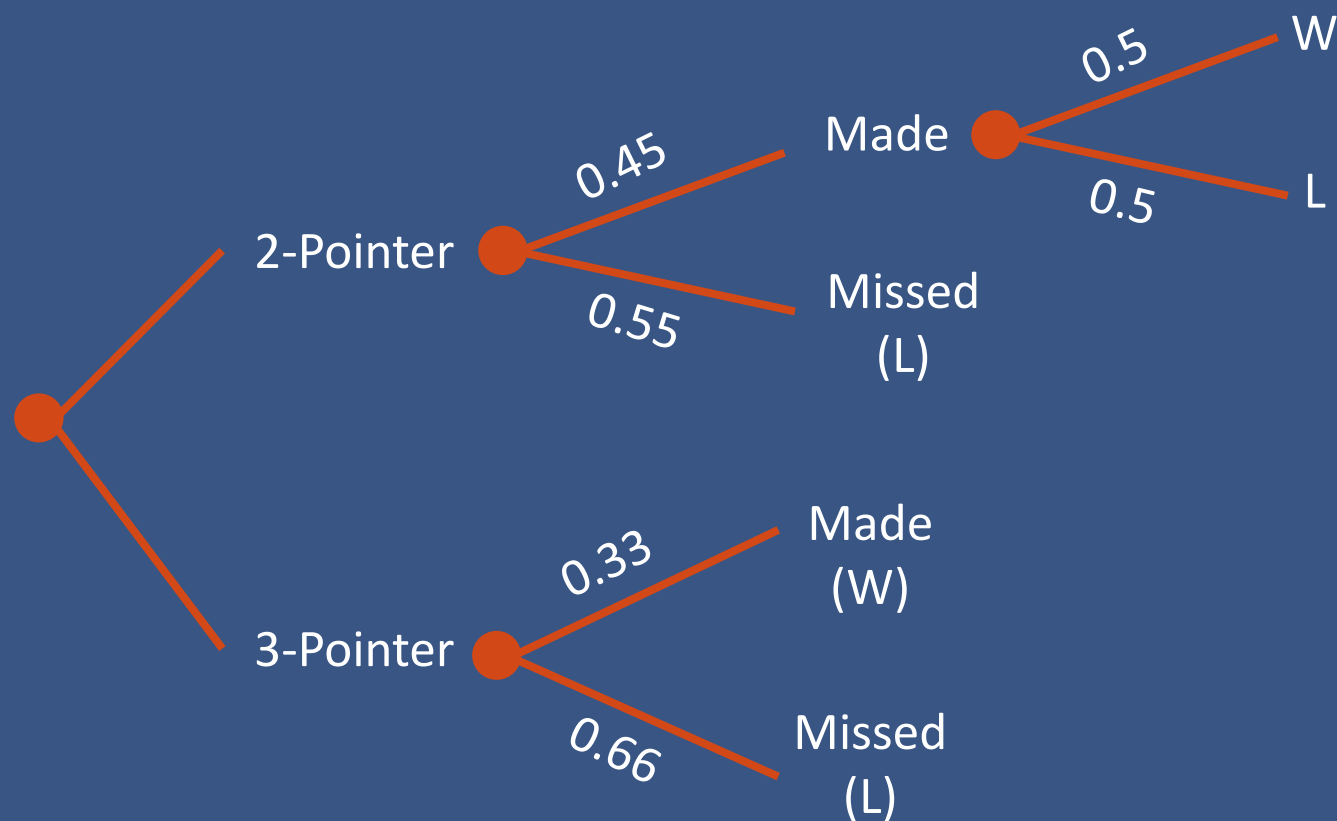
- If Attempting 2-Pointer, We Win if Shot is Made and Win in Overtime
- If Attempting 3-Pointer, We Win if Shot is Made



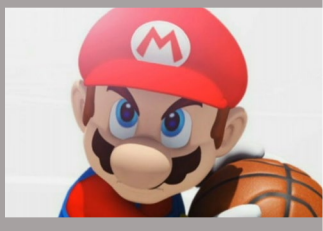
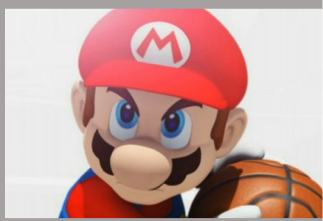
# End-Game Strategy

- Decision Making for Situation 1

- Decision Tree



- Find Probabilities By Multiplying Across Branches





# End-Game Strategy

- **Decision Making for Situation 1**

- Probability of W Given Attempting 2-Pointer

$$P(W|Attempt\ 2 - Pointer) = P(A) \times P(C) = 0.45 \times 0.5 = 0.225$$

- Probability of W Given Attempting 3-Pointer

$$P(W|Attempt\ 3 - Pointer) = P(B) = 0.333$$

- Reality: Most Coaches Will Go for 2-Pointer Due to Perceived Risk
  - Conclusion: Always Go For 3-Pointer.
  - Sensitivity Analysis (Cases Where 2-Point Attempt is Better)
    - Suppose We Have a Play That Scores a 2-Pointer 80% of the Time

$$P(W|Attempt\ 2 - Pointer) = P(A) \times P(C) = 0.8 \times 0.5 = 0.4$$

- Suppose Our Best 3-Point Shooter Scores a 3-Pointer 20% of the Time

$$P(W|Attempt\ 3 - Pointer) = P(B) = 0.20$$

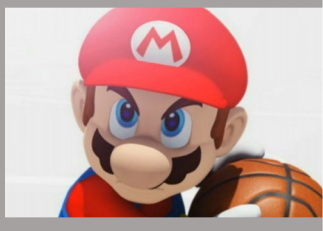
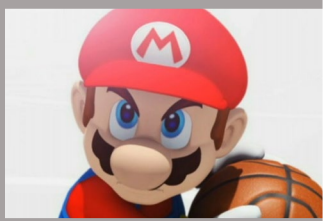
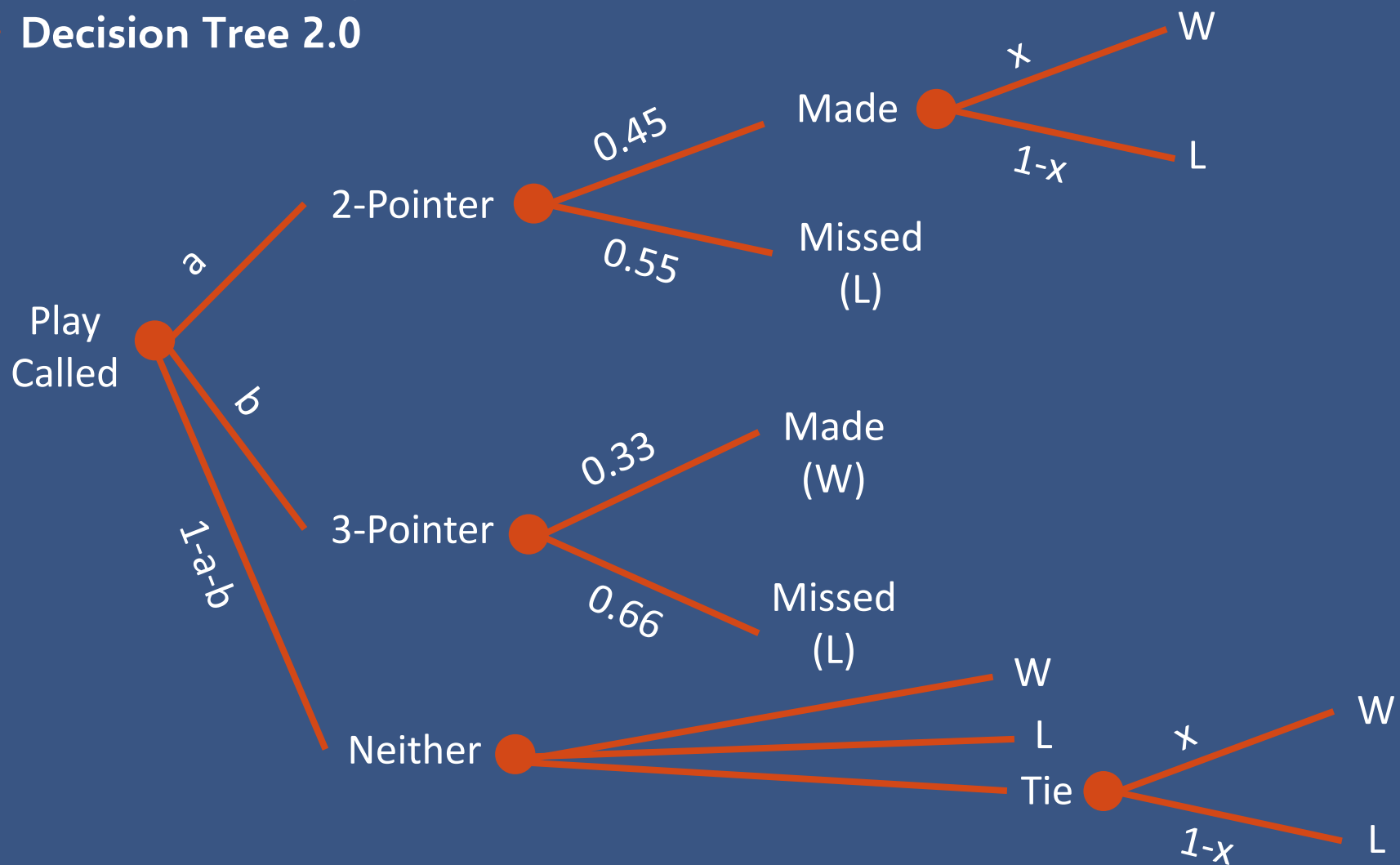




# End-Game Strategy

- Decision Making for Situation 1

- Decision Tree 2.0







# End-Game Strategy

- Decision Making for Situation 2

- Two Researchers Concluded Defensive Team Should Foul

- Adrian Lawhorn (Contributor to Hoops Habit)
    - David Annis (Statistical Consultant in Charlotte)

- Based on Annis Lawhorn

- Assume Last Possession
    - Within 11 Seconds, Offensive Teams Scored 3-Pointers 20% of the Time

$$P(\text{Other Team Wins} | \text{You Don't Foul}) = 0.2 \times 0.5 = 0.1$$

- If Defensive Team Fouls, Offensive Team Must Intentionally Miss a Free Throw
    - In This Circumstance, There is a 5% Chance of Tying the Game

$$\begin{aligned} P(\text{Other Team Wins} | \text{You Foul}) &= 0.75 \times 0.14 \times 0.47 \times 0.5 \\ &= 0.05 \times 0.5 \\ &= 0.025 \end{aligned}$$





# End-Game Strategy

- Decision Making for Situation 2

- 32 Games where Team Trailed by 3 Points and Leading Team Fouled

$$\frac{7 \text{ Ties}}{32 \text{ Games}} = 21.9\% (\pm 14.6\%)$$

- Bad Assumption Because Multiple Possessions Possible
- Historical Aggregation Shows Probability of Winning Higher if Leading Team Doesn't Foul (2005-2008)

Scenario	Sample Size	Probability Leading Team Wins	95% CI
Close Game Where Leading Team Didn't Foul	260	91.9%	(88.5%, 95.2%)
Close Game Where Leading Team Did Foul	27	88.9%	(76.8%, 100%)

95% Confidence Interval for Proportion:

$$\hat{p} \pm 2 \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$







# Final Inspiration

I cannot dunk a basketball,  
but I can Dunkin' Donuts.

- Mahatma Mario