



# 2-6-Tennis-Soccer-Data

2020年6月6日 星期六 下午2:41



2-6-Tennis...




## Data: Professional Sports and Mixed Strategies

Game Theory Course:  
Jackson, Leyton-Brown & Shoham

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## Mixed Strategies




- Some counter-intuitive features...
- Do people really play them?

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## Professional Soccer - Penalty Kicks




- Ignacio Palacios-Heurta (2003) "Professionals Play Minimax" *Review of Economic Studies*, Volume 70, pp 395-415
- 1417 Penalty kicks from FIFA games: Spain, England, Italy...
- Ignacio considers left, center, or right choices, and considered which leg the kicker used; I will keep it down to left and right choices (his page 402) ignoring kicker's leg.

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## Soccer Penalty Kicks



Kicker/Goalie	Left	Right
Left	.58, .42	.95, .05
Right	.93, .07	.70, .30

$p_G$     $1-p_G$   
Goalie win 42% of time  
Kicker win 58% of time

$p_K$     $1-p_K$


$0.42 p_K + 0.07 (1-p_K) = 0.05 p_K + 0.3 (1-p_K)$   
 $0.37 p_K + 0.07 = 0.05 p_K + 0.3$   
 $0.32 p_K = 0.23$   
 $p_K = 0.72$   
 $1-p_K = 0.28$

$0.58 p_G + 0.95 (1-p_G) = 0.93 p_G + 0.7 (1-p_G)$   
 $0.37 p_G + 0.95 = 0.23 p_G + 0.7$   
 $0.14 p_G = 0.25$   
 $p_G = \frac{25}{14} = \frac{5}{2.8} = 1.78$   
 $1-p_G = 0.58$

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## Pause the Video and Solve the Game




- The Goalie's probability of going Left  $p_G$  versus Right  $1 - p_G$  must have the kicker indifferent
- The Kicker's probability of going Left  $p_K$  versus Right  $1 - p_K$  must have the goalie indifferent

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## Pause the Video and Solve the Game




- The Goalie's probability of going Left  $p_G$  versus Right  $1 - p_G$  must have the kicker indifferent
- $p_G .58 + (1 - p_G) .95 = .93 p_G + .7 (1 - p_G)$  or  $.25 (1 - p_G) = .35 p_G$  or  $p_G = 5/12 = .42$
- The Kicker's probability of going Left  $p_K$  versus Right  $1 - p_K$  must have the goalie indifferent
- $p_K .42 + (1 - p_K) .07 = .05 p_K + .3 (1 - p_K)$  or  $.23 (1 - p_K) = .37 p_K$  or  $p_K = 23/60 = .38$

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## Soccer Penalty Kicks



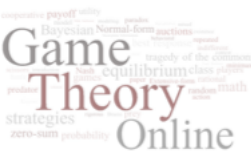
Kicker/Goalie	Left	Right
Left	.58, .42	.95, .05
Right	.93, .07	.70, .30

$0.42$     $0.38$   
 $0.38$     $0.42$

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## Soccer Penalty Kicks - The Data



	Goalie Left	Goalie Right	Kicker Left	Kicker Right
Nash Freq.	.42	.58	.38	.62
Actual Freq.	.42	.58	.40	.60


Goalie go to left 42% of time  
Kicker go to left 40% of time  
Goalie go to right 58% of time  
Kicker go to right 60% of time

indifferent  
Goalie's decision often - adjust - better pay off

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## Mixed Strategies




- Do players randomize well over time? Pretty well...
- How about under pressure? Do they become predictable? Statisticians/Game Theorists starting to keep them honest...
- Other sports: Tennis players and serves, M. Walker and J. Wooders, *American Economic Review* (2001) "Minimax Play and Wimbledon" volume 91, pp 1521-1538.

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## Summary - Mixed Strategies - Soccer Penalty Kicks




- Some games have mixed strategy equilibria
- A players must be indifferent between the actions he or she randomizes over
- Interesting comparative statics
- Do see randomization:

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  - in society and business interactions: audits by tax authorities!

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