WW

FACULTY OF ECONOMICS
AND MANAGEMENT

Master Thesis Seminar

Presentation

Prediction of Soccer Penalty Kicks using a Discrete Choice Model

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Introduction

50 %

*Dalton, Guillon & Naroo (2015, p.815-827)

Problem Description

- want to predict the shot direction
  - ➡ Estimate a Discrete Choice Model

- Discrete Choice - six possible alternatives:

TL	TC	TR
DL	DC	DR

- self-collected database

Learning Goals

Research Questions:

- Which variables are useful to predict the shot direction?
- Where does the penalty-taker most likely shoots the ball?
- How can we use our estimated probabilities to derive a suited prediction method?

Mathematical Model

- based on Koppelman & Bhat (2006, p.14-60)
- Choice: $C = \{i | U_{it} = \max(U_{it})\}$
- Utility: $U_{it} = V_{it} + \varepsilon_{it}$
- Probability:

$$Pr(i) = \frac{\exp(V_i)}{\sum_{j=i}^{J} \exp(V_j)}$$

ε_{it} = error term (unobservable)

V_{it} = observable utility

- character-based
- alternative-based

- Choice Method 2: $C_2 = \{i | Pr_i - \overline{Pr_i} = \max(Pr_i - \overline{Pr_i})\}$

Model Estimation Process

- package apollo of software R

- three main steps:

1. Pre-estimation analysis
2. Create order of variables
3. Test all variables individually

- output: - utility functions
  - useful variables

Results – Important Variables

- **Which variables are useful to predict the shot direction?**
- Where does the penalty-taker most likely shoots the ball?
- How can we use our estimated probabilities to derive a suited prediction method?

Results – Important Variables

- 15 different variables in model

Goalkeeper
- Height
- Movement
- Positioning
- Save-Rate

Match
- League
- Groupstage
- Ingame/Shootout
- Decider

Last Penalty
- Shot direction
- Success

Penalty-Taker
- Footedge
- Defender

Results - Probabilities

- Which variables are useful to predict the shot direction?
- **Where does the penalty-taker most likely shoots the ball?**
- How can we use our estimated probabilities to derive a suited prediction method?

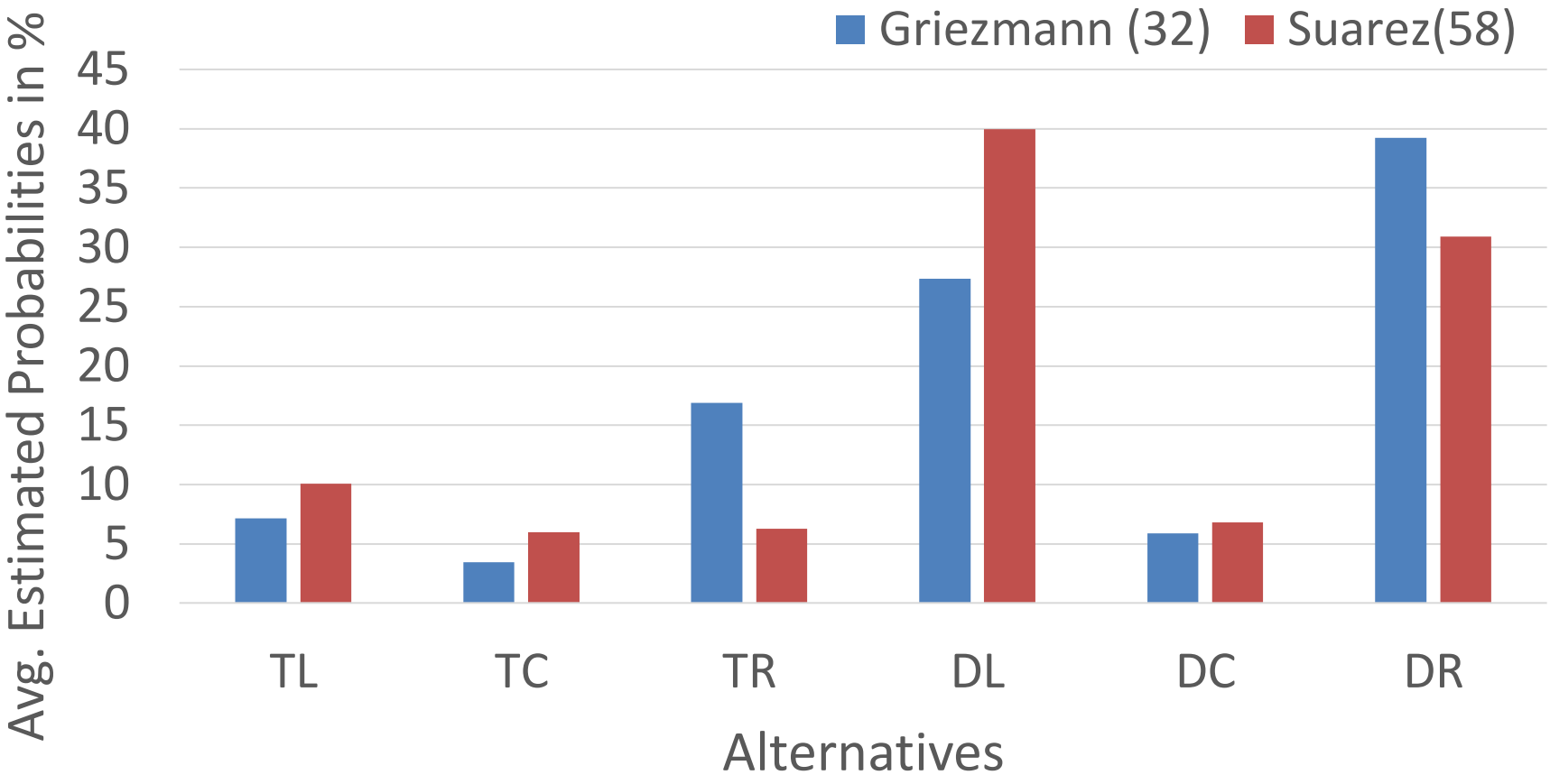
Results - Probabilities I

- average estimated probabilities

9,84 %	5,6 %	*8,99 %*	24,43 %
37,23 %	6,83 %	**31,51 %**	75,57 %
47,07 %	12,43 %	40,5 %	

- identical to distribution in database

Results - Probabilities II



- probabilities for single penalty-taker different

Results - Prediction

- Which variables are useful to predict the shot direction?
- Where does the penalty-taker most likely shoots the ball?
- **How can we use our estimated probabilities to derive a suited prediction method?**

Example

- Method 1: Maximum utility
- Method 2: Maximum probability increase

	TL	TC	TR	DL	DC	DR
$\Pr(i)$	0.128	0,043	0,203	0,24	0,074	0,3116
$\overline{\Pr(i)}$	0,098	0,056	0,09	0,372	0,068	0,3151
Δ	0.03	-0,013	0,113	-0,132	0,006	- 0,0035

Results - Prediction

- Maximum utility method with higher accuracy

	Method 1	Method 2
Prediction Rate	42,24 %	33,59%
TL	12	377
DL	1606	805
TC	1	177
DC	0	62
TR	20	274
DR	719	663

Conclusion

- a lot of different factors influencing the penalty-taker
- penalty kicks most likely flat to the corners
- difficult to predict shot direction