Artificial Turf Advantage and Predictive Accuracy in Dutch Football

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Presentation information

`https://github.com/gsverhoeven/artificial_turf_predictive`

You'll find:

- These slides
- The paper as a reproducible Markdown document

About this project

- Pet project not related to work (but positive externalities)
- My StanCon visit is paid for by my employer (the Dutch Healthcare Authority)
- Builts on work presented at first StanCon by Milad Kharratzadeh, as well as work by Ben Torvaney (`https://github.com/Torvaney/karlis-ntzoufras-reproduction`) and Rutger Lit

About Dutch Football

Figure 1 : European Championship 1988 Dutch Team

The Artificial Turf Advantage

- Extra home advantage due to artificial turf
- Two requirements:
  - The match is played on Artificial Turf
  - The away team has natural grass in their Home Stadium
- 2017 paper by Economist Jan van Ours: +0.5 extra goals per match
- Compare with:
  - Regular home advantage: +0.4 extra goals
  - On average teams score 1-2 times per match

Some facts on Dutch Eredivisie and Artificial Turf

- 18 clubs play in Dutch Eredivisie
- Eredivisie is highest professional league
- Per season, each team plays each other team twice
- Budget differs one order of magnitude between clubs
- Since 2014/2015 season, 6 out of 18 clubs have artificial turf in their home stadium
- Cost primary motivation for clubs to switch

Must haves for a parametric football model

- include regular home advantage ($+0.4$ goals on average)
- address correlation between home and away goals
- allow changes in team ability over time
- partial pooling of variance of team ability time evolution

Overview of the models

- Predict Goal difference of match Y_{ijt} between home team i and away team j at time t
- Y_{ijt} is a function of latent "scoring intensities"
  $Y_{ijt} = Y(\lambda_{it}, \lambda_{jt})$
- Two variants:
  $Y_{ijt} \sim t(\lambda_{it} - \lambda_{jt}, \sigma_Y, \nu)$
  $Y_{ijt} \sim Skellam(\lambda_{it}, \lambda_{jt}) \Leftrightarrow Y_{ijt} \sim Poisson(\lambda_{it}) - Poisson(\lambda_{jt})$

```
real skellam_lpmf( ... ) real skellam_rng( ... )
```

Model details

- Scoring intensities for Skellam model with Attack/defense abilities:
  $\lambda_{it} = exp(\mu + \delta + \kappa d_{ijt} + \alpha_{it} - \beta_{jt})$
  $\lambda_{jt} = exp(\mu + \alpha_{jt} - \beta_{it})$
- Team ability time evolution modeled by random walk
  $\alpha_{it} = \alpha_{i,t-1} + \eta_{it}$
  $\eta_{it} \sim Normal(0, \sigma_{it})$
- Priors weakly informative based on typical n_goals scored

The Core of Modern Statistical Workflow

- Fit model to fake data simulated from generative model

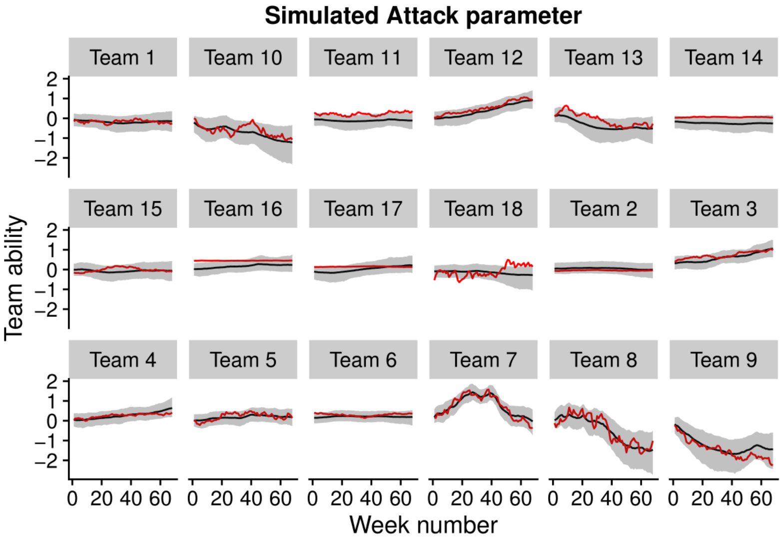


Figure 2

Partial pooling versus no pooling

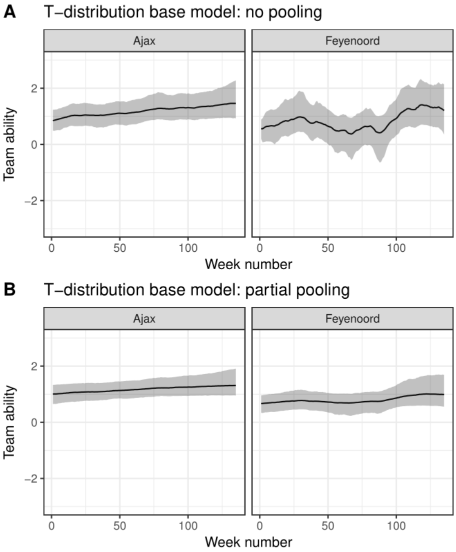
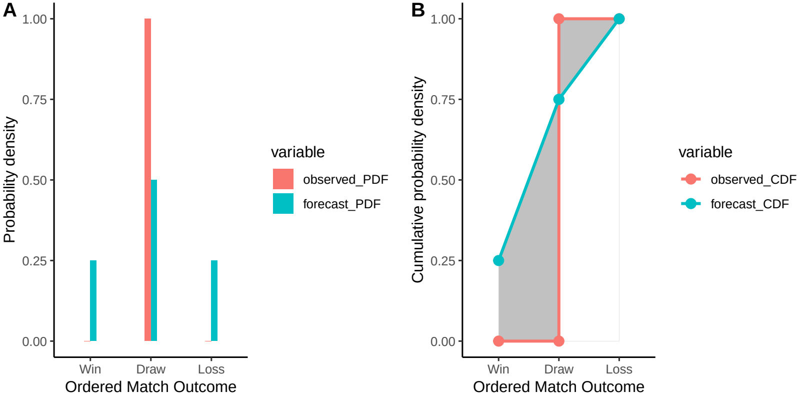


Figure 3

Forecasting approach

- Out-of-sample forecasts using expanding window
- Use posterior predictive distribution $p(y_{rep}|y)$ for next's week matches
- Gives for each match a probabilistic forecast $p_{win}, p_{draw}, p_{loss}$
- Use Ranked Probability Score to quantify discrepancy

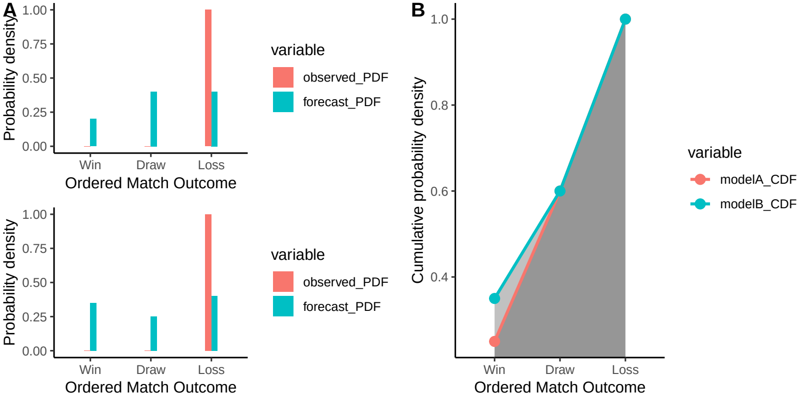
Ranked Probability Score (RPS)



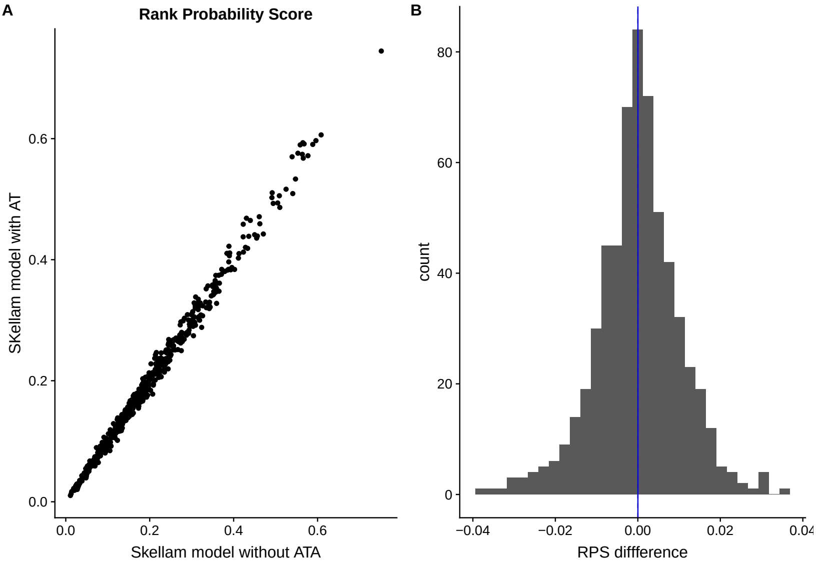

```
calculate_rps(rbind(c(0.25, 0.5, 0.25),
                    c(1/3, 1/3, 1/3)),
              rbind(c(0, 1, 0),
                    c(0, 1, 0)))

## [1] 0.062500 0.111111
```

Ranked Probability Score is distance sensitive



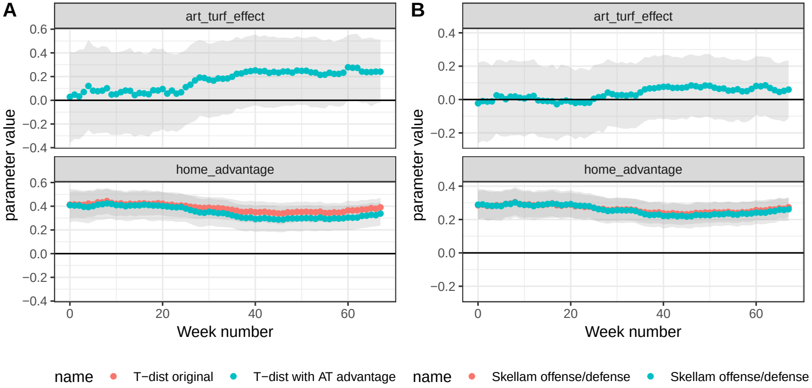
RPS for Skellam model with and without artificial turf



Results

Model	distribution	aRPS	DM statistic
Bet365 odds	Benchmark	0.1893	NA
William_hill odds	Benchmark	0.1902	-1.5
Skellam, no zif, offense/defense	Skellam	0.1914	-1.3
Skellam offense/defense with AT	Skellam	0.1917	-1.4
Skellam offense/defense	Skellam	0.1917	-1.4
Skellam single ability	Skellam	0.1920	-1.7
T-dist original	T-dist	0.1921	-1.7
T-dist with AT advantage	T-dist	0.1923	-1.7
T-dist no pooling	T-dist	0.1957	-3.0
T-dist no HA	T-dist	0.1981	-2.9
Equal probability odds	Benchmark	0.2375	-8.4

Artificial Turf Advantage Coefficient



Summary

- Implemented dynamic Skellam model in Stan
- Models using data on goals scored do not beat bookies but come close
- Artificial Turf Advantage (ATA) does not improve forecasts
- Evidence for a large effect of ATA is not strong
- Is comparing predictive accuracy the best way to learn about the DGP?

Thanks!