Final Project: Individual Report

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Mathematical Modelling of Football

I. INTER MILAN: STRATEGIC APPROACH

Working Backwards From The Deliverable

The Inter Milan Player Performance group performed with the efficiency and ambition of a professional data science team. There was no wasted work. A key strategy for our group, given a tight deadline to deliver both a piece of analysis and an accompanying presentation, was to start with the ideal structure for the presentation, and work backwards to populate that structure with content. This strategy was highly effective, as it required the motivation of the work (and thus the presentation) to be established on day one, and gave team members the freedom to work on whatever they found most interesting within a structure that meant everything contributed toward the final deliverable.

Divide & Conquer

As the largest group within the tutorial team, it was essential to get through the data preparation bottleneck as quickly as possible. Easily digestible data in CSV form that could be read into pandas with a single line of code was in place a day or two after the project was set. This enabled the team to parallelise its resources almost immediately, with each team member producing position-specific player performance metrics for two or three positions. This provided a practical dash of redundancy per position as well as different approaches to similar metrics that were compared to sanity check the analysis.

Two Datasets

The centralised data preparation provided two datasets to produce player performance metrics from: a "pure" Wyscout load transforming the various raw Wyscout JSON files into dataframes; and an "xT" load, applying Karun Singh's xT implementation to SPADL-converted Wyscout data.

Expected threat (**xT**) was selected as the player action value framework of choice over VAEP as the academic literature comparing the two cite xT as being more robust and intuitive, and less complex than VAEP. A primary weakness of xT with respect to VAEP is that it does not value a player's overperformance on shots (i.e. the number of goals they actually score versus the expectation). A straightforward approach that we took to mitigate this was to also include adjusted expected goals (**xG**) in our player performance metrics for relevant attacking positions.

Solutions That Move The Needle

The final part of the team's strategic approach to the project was to perform analysis offering solutions that would move the needle at a professional football club, by asking the following questions:

- Who are the high / low performing players within the Inter squad?
- Which players could be recruited to replace Inter's key assets, should clubs like Bayern, Barcelona, or Real Madrid come calling?
- Which players could be recruited to strengthen positions of weakness?
- Which players could be recruited to add strength in depth given the increased demand for player resource following Champions League qualification?

II. INTER MILAN: ANALYSIS SUMMARY

Analysis Highlights

The Inter Milan group successfully delivered a comprehensive set of position-specific player performance metrics for a range of positions. The metrics were derived using the xT value action framework, as well as using other complementary models and algorithms – and finishing with some more traditional metrics.

xT is a possession-based framework, meaning the only actions it provides values for are actions that move the ball between pitch zones (i.e. crosses, passes, dribbles). xT values are only attributed to successful actions, meaning an xT-based dribble metric summarises a player's tactical ability to identify threatening areas to move into, but lacks the context of dribble success rate and the dribbler's ability to beat a man to get there. To fill this gap, we created a bespoke mean ELO dribble system after matching attackers and defenders within the Wyscout **duel** event taxonomy to produce both a dribbler and a dribble defender rating.

FIG. 1 showcases these ELO and xT-based metrics for wingers, with goals above expectation (with separate models and metrics for headers and non-headers) and touches in the opponent's box metrics rounding out the radar. Inter's strongest winger Perišić is compared with a systematically identified replacement candidate Alexis Sanchez (out-of-form star at Manchester United) as well as back-up candidate Victor Moses (squad player at Chelsea). Should Manchester United come back with another bid for Perišić as they did the previous summer, our analysis would support the recommendation to Inter's senior management to attempt to swap Perišić for Sanchez, a superior passer to Perišić who can do everything but score at Manchester United.

An attractive property of our methodology is that the systematic construction of position-specific KPIs enables us to create a timeseries per metric per player with which to track rising stars and declining veterans. FIG. 2 shows another position covered by our analysis, centre halves, displaying the complementary *Artist-Tank* partnership between newly-signed Škriniar (the risk-taking *artist* capable of playing out from the back and scoring headed goals) and veteran Miranda (the experienced *tank* who dominates physically, whether it be in the air, on the ground against the dribble or a striker with back to goal). Our analysis would allow Inter management to track Škriniar's development and systematically identify when Miranda needs to be replaced.

An innovative piece of analysis that provides data-driven insight into a team's weak point (whether that team be Inter or an opponent) is our *Delta xT Strategy* analysis. The following methodology produces a *Delta xT* grid for Inter:

- Calculate the average opponent threat per zone *excluding* Inter;
- Calculate the average opponent threat per zone *versus* Inter;
- Sum the threat deltas (*versus* Inter − *excluding* Inter) for all opponents.

Delta xT intuitively shows where opponent's deviate from their usual threat strategy when playing against Inter, where the 2017/18 analysis can be seen in FIG. 3 (Dortmund and Real Madrid's *Delta xT* is also
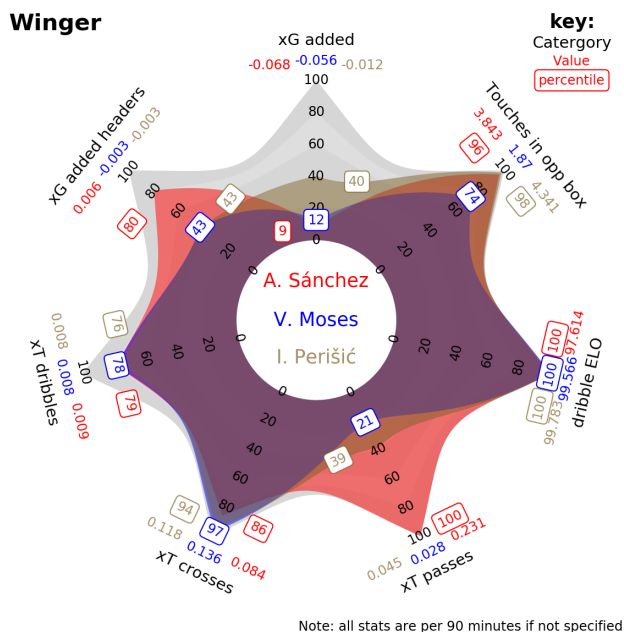
Winger

FIG. 1: Winger radar comparing star Inter winger Perišić with a systematically identified replacement candidate Alexis Sanchez and back-up candidate Victor Moses.
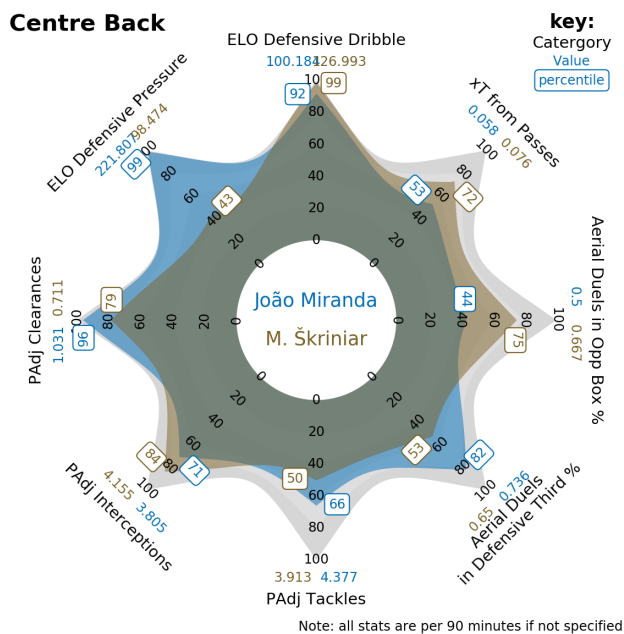
Centre Back

FIG. 2: Centre back radar highlighting the complementary *Artist-Tank* partnership between Škriniar and Miranda.

FIG. 3: *Delta xT Strategy* for Inter Milan, Borussia Dortmund, and Real Madrid. On average, opponents against these teams deviate from their usual strategy to target the left back.

shown, as they also show defensive frailty at left back).

D'Ambrosio, a right-footed right back, was preferred over left backs Nagatomo, Santon, and Dalbert in the left back position. It's facinating to see from FIG. 3 just *how wide* Inter were targeted on the left side of the defence, suggesting that opponents tactically attacked D'Ambrosio's weaker foot to gain an advantage.

Limitations Of The Analysis

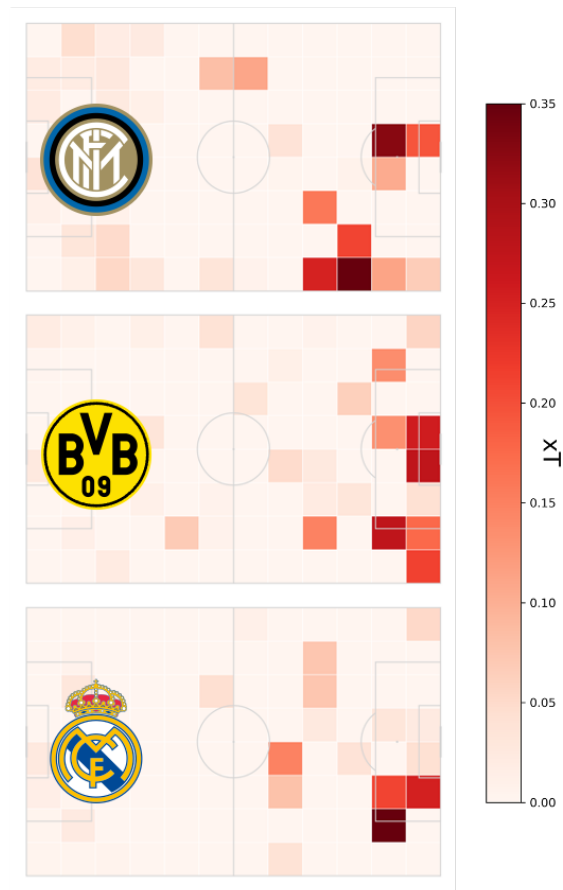It was a practical decision to convert Wyscout events to SPADL format given the tight timeline for this project. It enabled the group to quickly train and apply Karun Singh's implementation of xT requiring SPADL formatted input, rather than developing the xT Markov chain model from scratch on the "pure" Wyscout data. Whilst the idea motivating SPADL is attractive in theory – to have a single representation of football events data taking either Opta, Statsbomb, or Wyscout data as inputs – in practice it reduces the events dataset you're working with down to the lowest common denominator shared by two other datasets that you may not have access to or be interested in. This significantly reduces the richness of the chosen dataset (SPADL clips around a third of all Wyscout events). When attempting to join the "xT" dataset back to the "pure" dataset, it became clear that **duel** events in particular were being lost through the SPADL transformation. Dribbles are derived from subcategories within the duel event taxonomy, and therefore it's likely that the SPADL representation of dribbles and in turn the xT model attributing value to dribbles is suboptimal (*this issue is clearly caveated in the underlying SPADL code*).

Naturally, there are a few limitations of the xT model even if it was fed with the ideal dataset. Since it's location-based, it fails to incorporate game context such as time of game, game score, and whether or not a team has received a red card and is a player light. There's also no mathematical machinery to penalise players for failed actions, as the model only applies threat values to successful actions.

Lastly, there's a limitation with respect to player recruitment that applies to all value action models: what goes on between a player's ears goes unrecorded. Since Sir Alex Ferguson's departure from Manchester United, a criticism of their recruitment is that newly-signed players often don't fit the United culture despite being superstars on paper. It's interesting to learn that to try and rectify this, Ole Gunnar Solskjaer now requires a systematic character analysis from players / coaches within his network for transfer targets as part of late-stage recruiting analysis.