Maximizing financial and on-field performances when composing teams in soccer

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The Football Team Composition Problem: a Stochastic Programming approach

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Abstract: Most professional European football clubs are well-structured businesses. Therefore, the financial performance of investments in players becomes crucial. In this paper, after the problem is discussed and formalized, an optimization model with the objective of maximizing

Bouchet et al., 2015), merchandising, and social media visibility.

In this context, one of the key decisions for football club managers, in order to stimulate earnings, is the hiring of professional players to compete for the club. In fact, Dobson and Goddard (2001, Ch.2) state that the

- Maximize expected financial gain
- Based on the market value of players

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Modelling the financial contribution of soccer players to their clubs

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- Evaluate financial gain from sporting success
- Based on the squad's ability to perform well in competitions

Our aim is to present a mathematical model to balance financial and sporting criteria

- Maximize quality of team
- Keep profits/losses above an acceptable threshold with a certain probability

The objective is to maximize the sum of ratings for players on the team

The rating of player *p*

$$\max \sum_{p \in \mathcal{P}} R_p(y_p + x_p^B - x^L)$$

Equals 1 if player is owned by the club or has been loaned, and has not been loaned out

The players on a team must satisfy certain requirements by the manager and others

$$y_p - y_p^P + y_p^S = Y_p$$

Sets whether player *p* belongs to team

$$\sum_{p \in \mathcal{P}} (y_p + x_p^B - x_p^L) = N,$$

$$\sum_{p \in \mathcal{P}_r} (y_p + x_p^B - x_p^L) \geq \underline{N}_r$$

$$\sum_{p \in \mathcal{P}_r} (y_p + x_p^B - x_p^L) \leq \overline{N}_r$$

Make sure that the team has players that sufficiently fulfill the roles required (e.g., at least 2 goalkeepers, etc.)

$$x_p^B + y_p^P \leq 1 - Y_p$$

$$x_p^L + y_p^S \leq Y_p$$

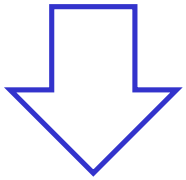
Restrict loans in/out

$$\sum_{p \in \mathcal{P}} (V_p^P y_p^B + V_p^B x_p^B - V_p^S y_p^S - V_p^L x_p^L) \leq B,$$

Cannot violate the budget

The expected value of the team in the future must also be above a certain threshold, with a given probability

$$P\left(\sum_{p\in\mathcal{P}} \tilde{V}_p y_p \geq V\right) \geq \alpha,$$



$$\sum_{p\in\mathcal{P}} V_{ps} y_p + M(1-w_s) \geq V \quad s \in \mathcal{S}$$

$$\sum_{s\in\mathcal{S}} \frac{1}{|\mathcal{S}|} w_s \geq \alpha$$

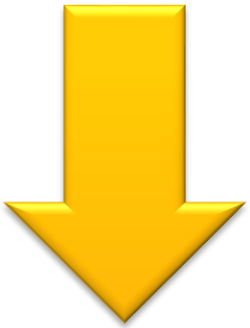
(+ all variables being binary, i.e., in {0, 1})

The model makes some bold assumptions

- The team can choose to bring in any players from a set of candidate players (either by loan or purchase)
- The team can choose to send away any players from the current squad (either by loan or sale)
- Each player has a single number (rating) that describes the players quality

There are two philosophies regarding how to quantitatively rate football players

Team performance given the presence or absence of specific players



Top-down ratings

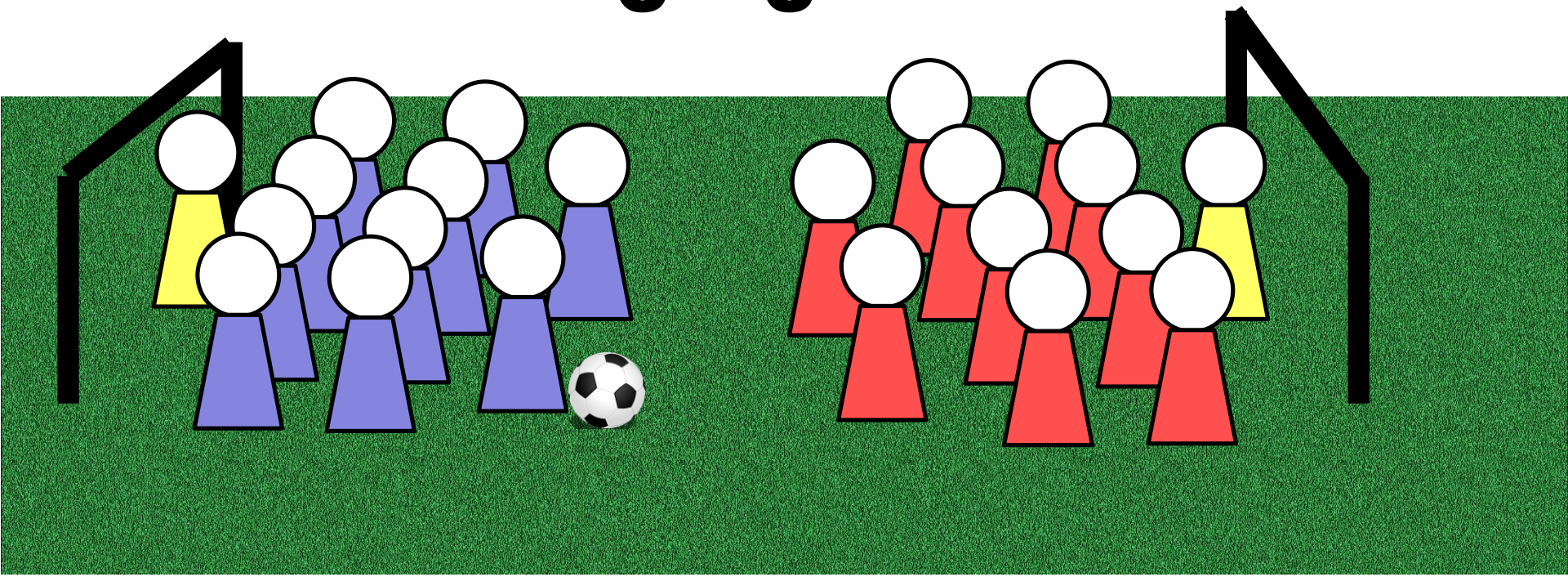
Bottom-up ratings

Detailed player actions: goals, saves, dribbles, passes, missed penalties, sprints, mileage, tackles, bookings, interceptions.

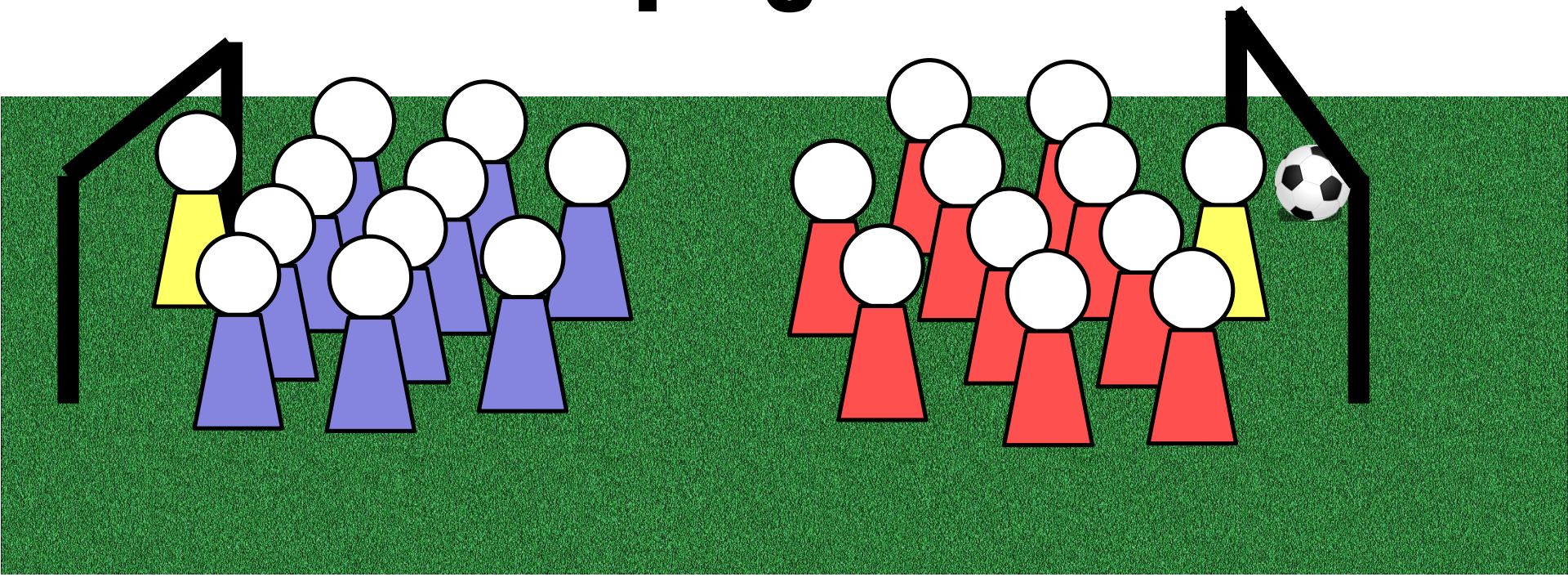
Plus-minus ratings have been suggested as a top-down measure of player quality

In its original form: a raw statistic counting the number of goals scored minus the number of goals conceded from the perspective of each player...

0 - 0



1 - 0



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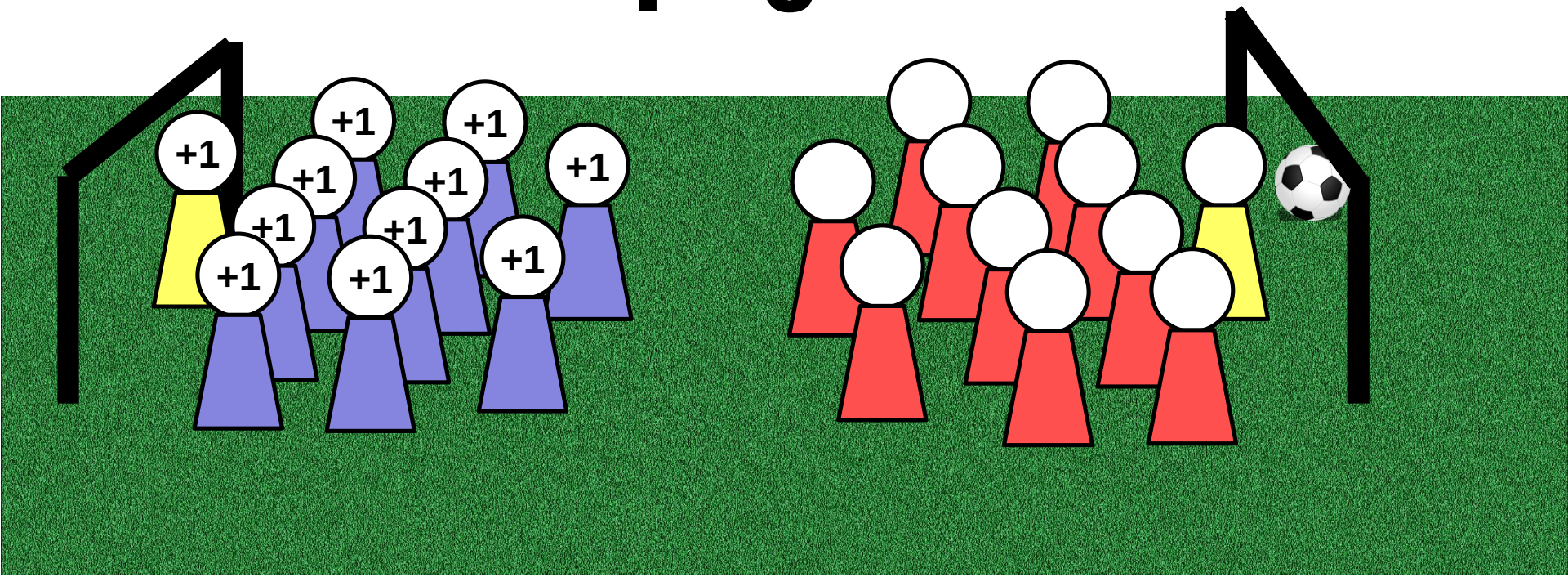

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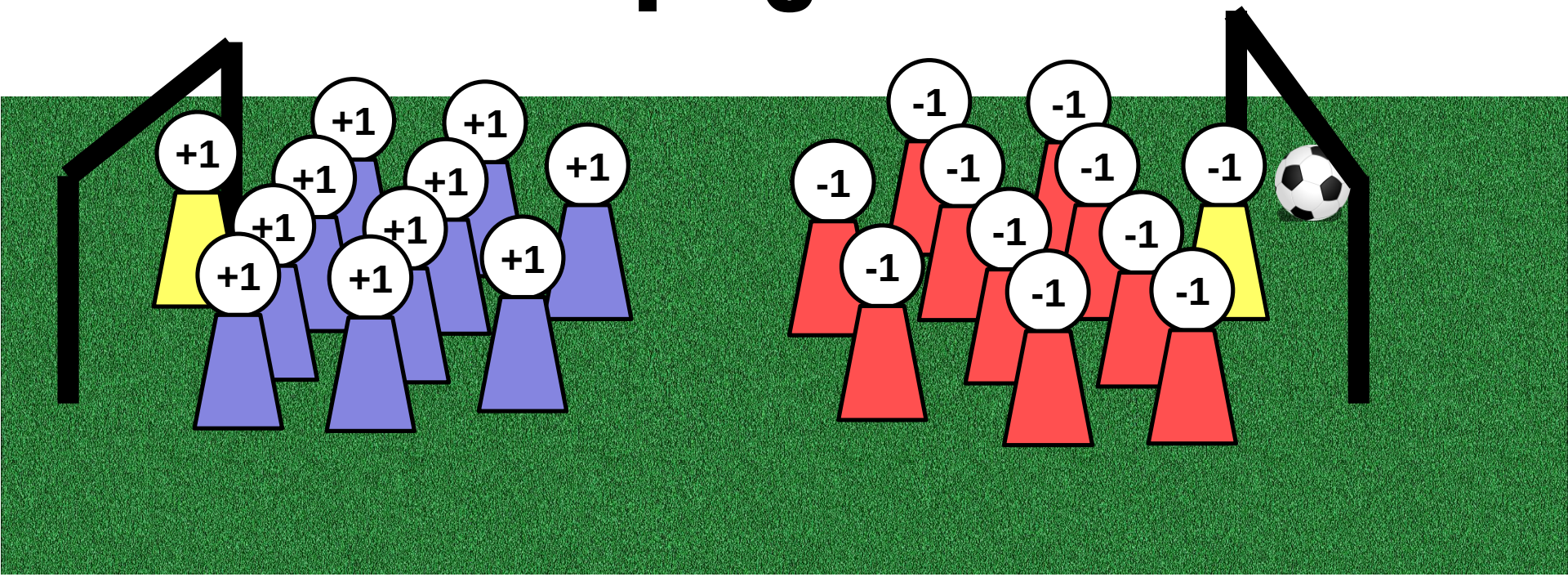


Plus-minus ratings have been suggested as a top-down measure of player quality

...drawback: even bad players can get good scores when playing for good teams (against bad teams)

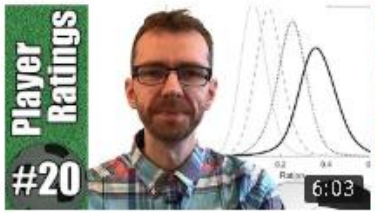
-> Adjusted plus-minus ratings were developed to compensate for this

-> Regularized adjusted plus-minus addressed issues of collinearity and players with few minutes played

-> Further improvements made by the authors...

You can find more information about +/- ratings on YouTube

Improving player ratings by differentiating between...



Improving player ratings by differentiating between...

Best old players in the English Premier League...

Best young players in the English Premier League...

Review of ratings in Sæbø and Hvattum (2018)

www.enexto.com

Before looking at some results from artificially applying the model, let's consider the uncertainty

Future value of player p (scenario s)

The age group of player p is a

$$V_{ps} = \left(\alpha_a \sqrt[4]{V_p^C} + \sum_{r \in \mathcal{R}} \beta_{ar} \delta(p, \mathcal{P}_r) \right)^4 * (1 + \epsilon_{as})$$

Current value of player p

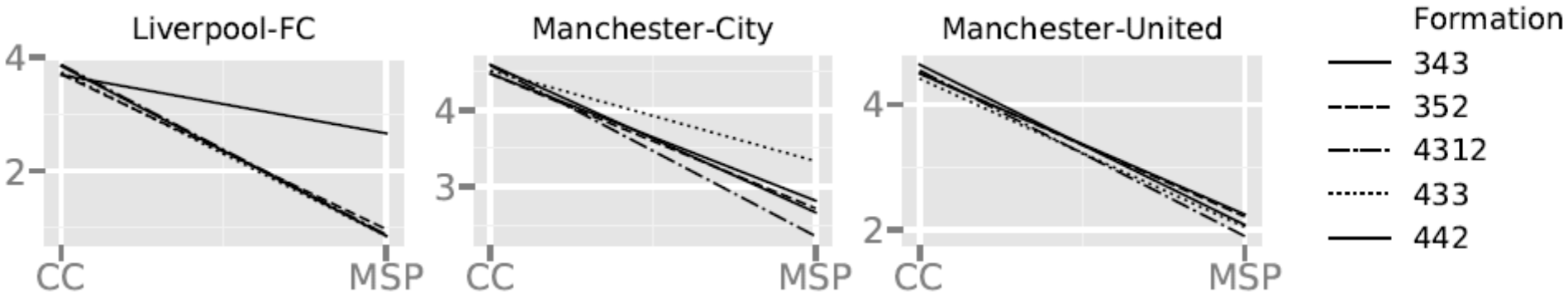
Indicator for role r of player p

Sample from error distribution of regression

Data

- Player values: EPL 2011/12 – 2016/17
- Ratings: 84,000 matches up to July 1, 2014
- Teams in final tests: 20 teams of EPL 2013/14
- Players available for transfers: those actually moving in the 2014 summer transfer window

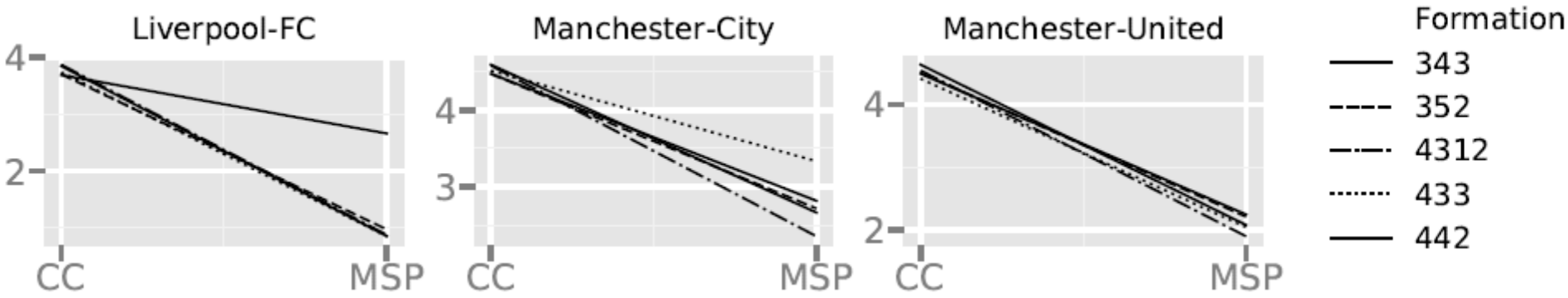
Total team rating for new team composition



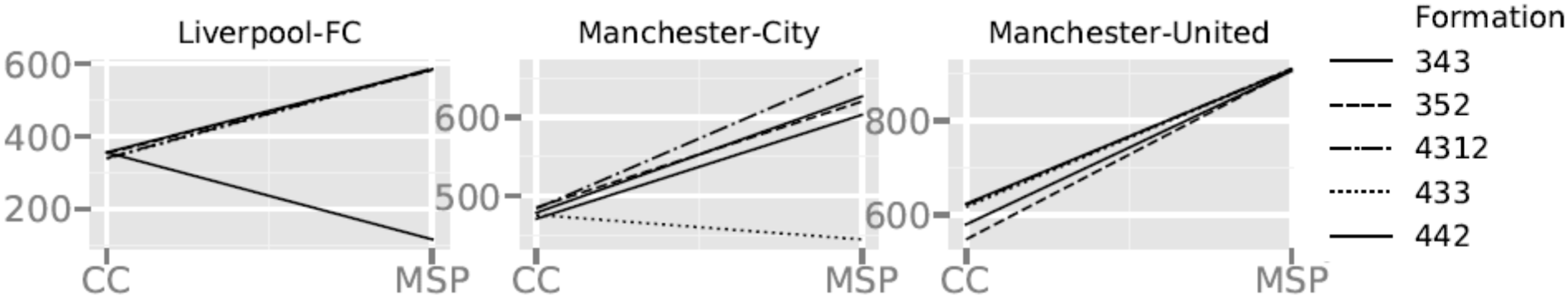
CC = our new model

MSP = model only maximizing expected value

Total team rating for new team composition



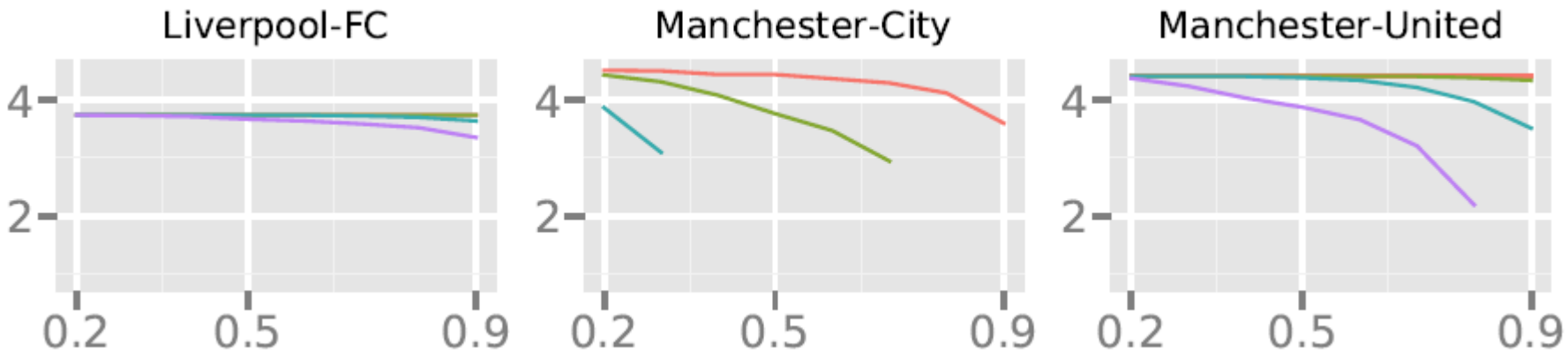
Expected value after one year



CC = our new model

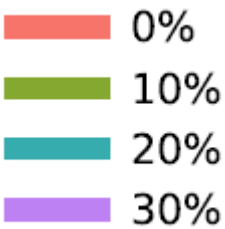
MSP = model only maximizing expected value

The total team rating with the new model depends on some model parameters

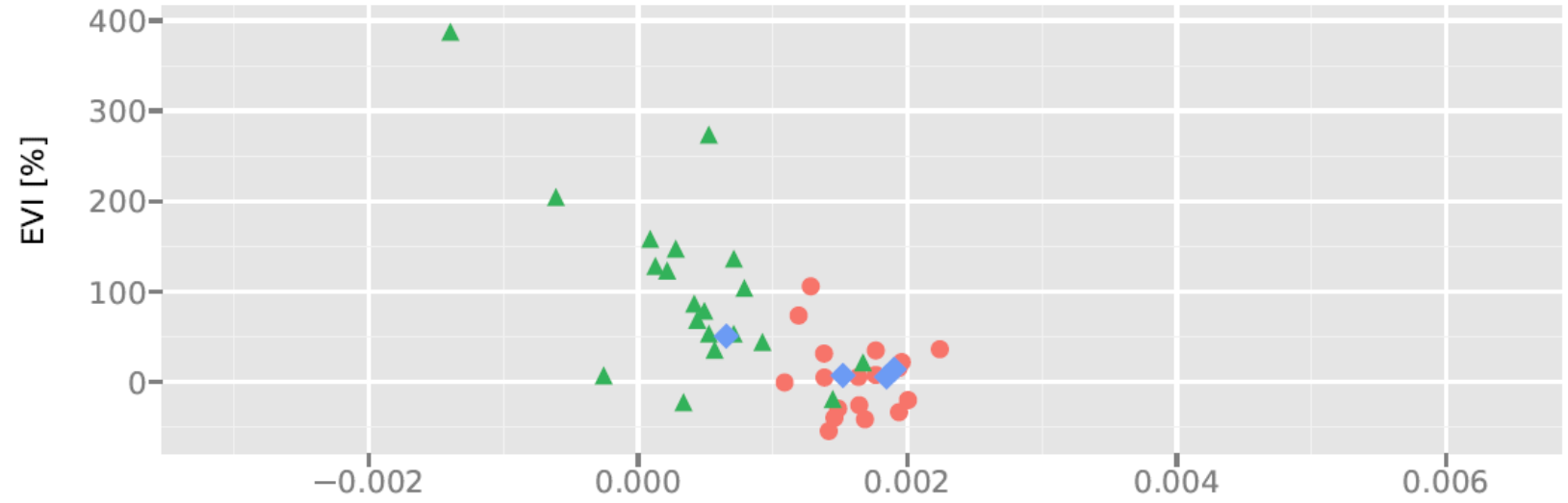


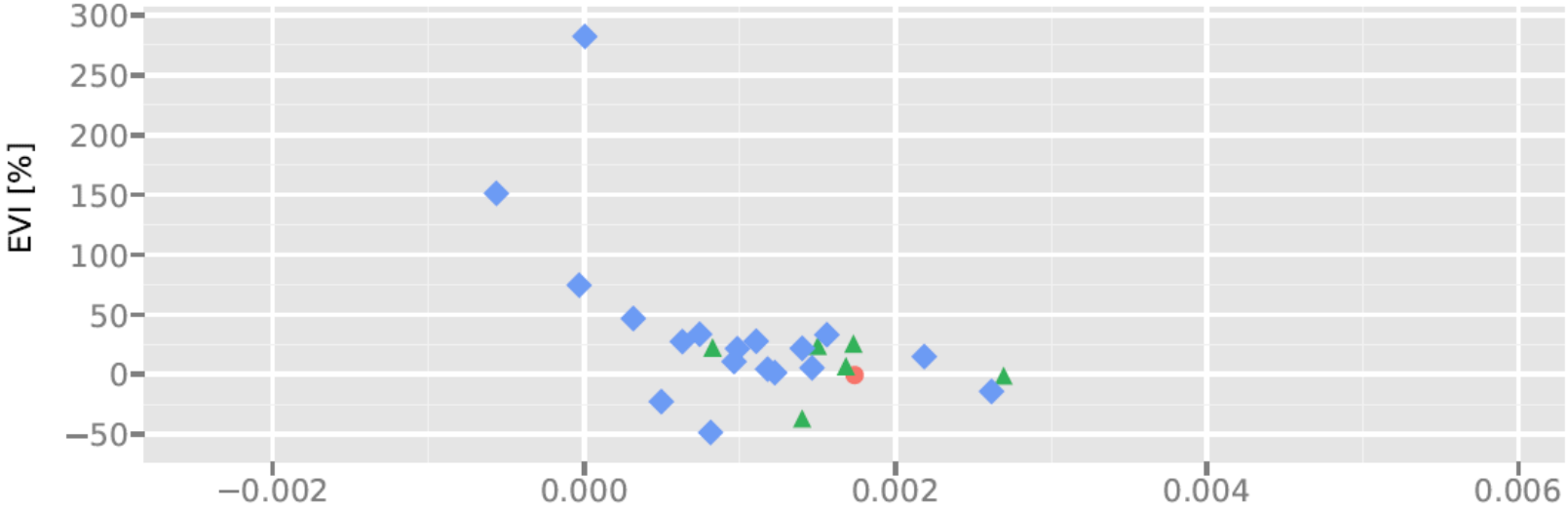
x-axis: probability of satisfying expected value requirement

colors: required growth of value

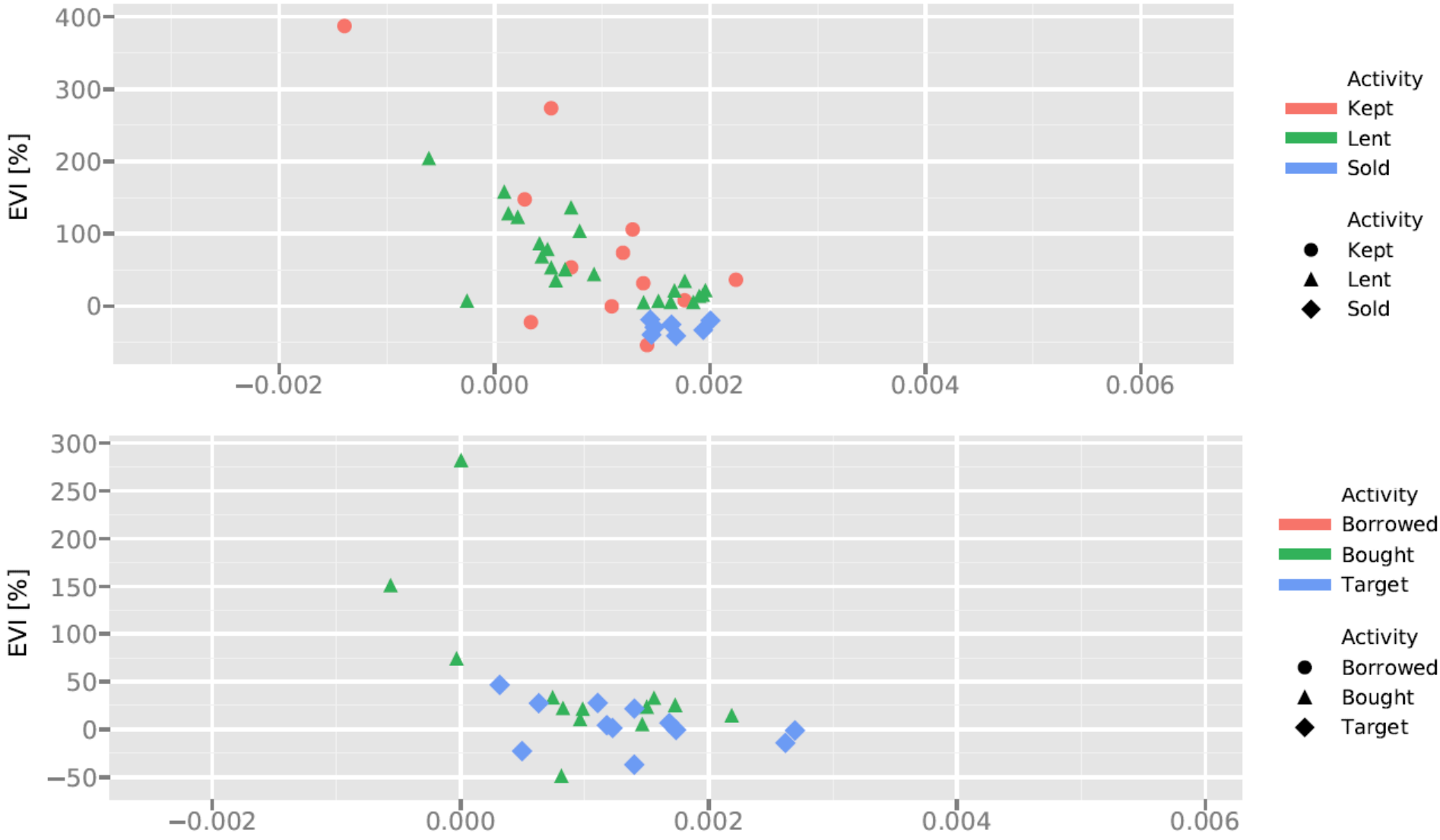


Example: Chelsea, 20 % chance of meeting value requirements (top: current squad, bottom: targets)





Example: Chelsea, 80 % chance of meeting value requirements (top: current squad, bottom: targets)



Takeaways

- A better understanding of the importance of age in composition of team rosters (future value vs. sporting contribution)
- Identification of players in a squad that are candidates for being replaced
- A technique to prioritize among candidates for recruitment, given the use of data-driven scouting tools