Clustering GAM-Smoothed NFL Elo Ratings

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What Are Elo Ratings?

Elo ratings are used by FiveThirtyEight to predict the outcome of head-to-head matchups between NFL teams. They were originally developed for prediction of chess matches but have been extended to sports analytics.

- Very little information needed to calculate
- Teams with higher Elo Ratings should beat teams with lower Elo Ratings
- Can be interpreted as point spreads for matchups

Project Goal

The goal of this project is to **smooth** season-long measurements of Elo ratings for each NFL team. Then, I'm interested in **clustering** team-year Elos into a handful of groups. Research by Hitchcock, Booth, and Casella (2007) indicates that smoothing, while not necessary, does improve cluster fits.

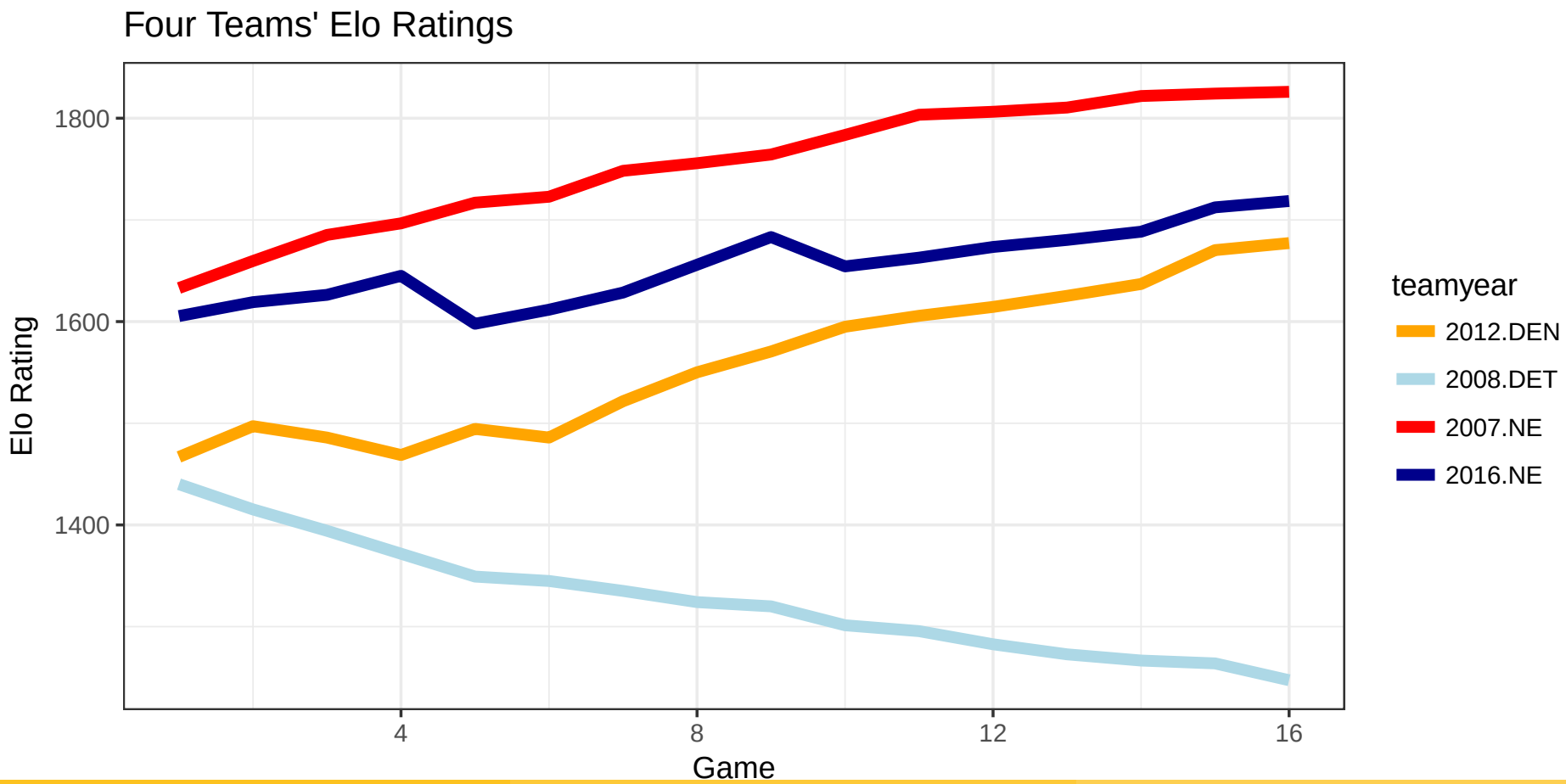
Why Do We Care About Classifying Elo Ratings?

Team decision makers may want to develop a sense for the type of team that they have, given that not all teams realistically have a chance at winning a championship in every year. Sorry, Broncos and Browns fans...

- We want to make **comparisons** between different teams in different seasons.
- Identification of **team value**: teams that win a lot or improve during the season may be more valuable than those that get worse or stay bad.
- Allows for assessment of team **parity**.

The Data

We have **32 teams** with 16 games per season over 15 seasons, leading to 480 curves that need to be smoothed with GAMs. Each team/year combination is considered independent.



GAM-Smoothed Estimates

- Elo Ratings can be noisy! It might be better to estimate a mean trend.
- I used GAMS to estimate smooth versions of these noisy trends in Elo.

A Very Complicated Model:

$$\hat{Elo}_{ij} = s_{ij}(game_{ij})$$

Notationally, i refers to team/year combination (1..480) and j refers to game within season (1...16).

- Technically, there are 480 smoothed models fit here
- They may involve differing EDFs for each model depending on how wiggly things need to be

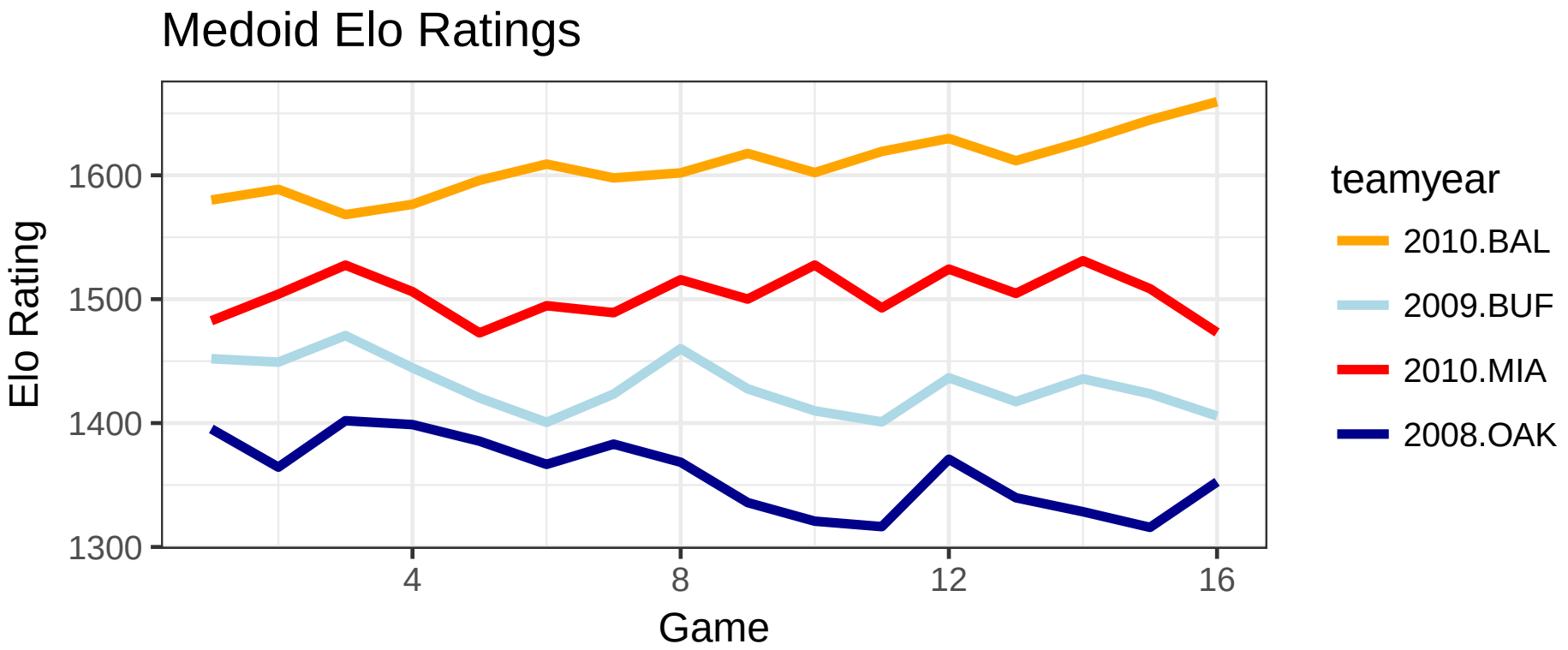
Functional Data Clustering

We can then take these curves and calculate distances between each of the GAM smoothers. We can generate a 4-cluster solution based on a technique called **Partitioning Around Medoids** (PAM). The Idea:

- Determine 4 "medoid" GAM fits
- For each GAM, figure out which medoid is closest - that's the cluster that each observation goes in

4-Cluster Solution

Contenders: 2010 Baltimore Ravens, **Status Quo**: 2010 Miami Dolphins, **Pretenders**: 2009 Buffalo Bills, **Loveable Losers**: 2008 Oakland Raiders



Selected References

Glickman, Mark E. and Jones, Albyn (1999).“Rating the Chess Rating System”. *Chance*. pp.21-28.

Silver,Nate (2014). “Introducing NFL Elo Ratings” _https://fivethirtyeight.com/features/introducing-nfl-elo-ratings_

Hitchcock, David B., Booth, James G., and Casella, George. (2007). “The Effect of Pre-Smoothing Functional Data on Cluster Analysis.” *The Journal of Statistical Computation and Simulation*. pp. 1043-1055.

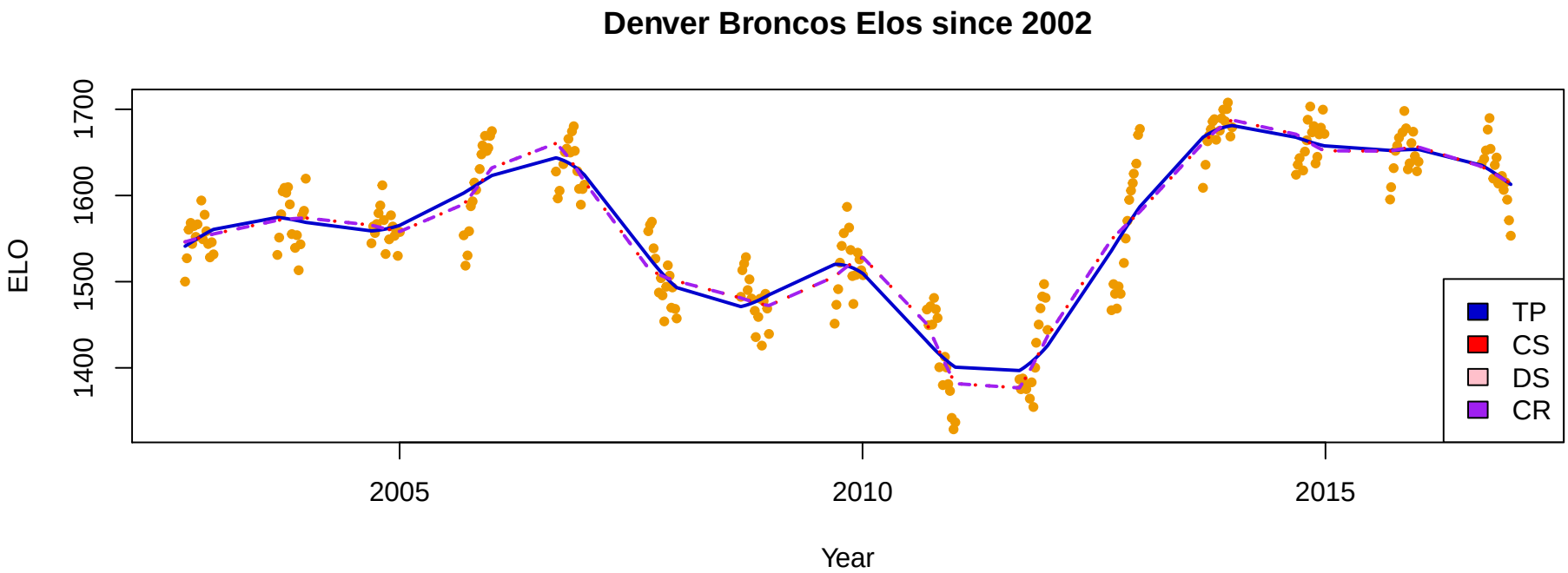
Wood, Simon.(2017). *Generalized Additive Models: An Introduction with R*. Ed 2.Chapman and Hall/CRC.

Questions

Figure 1

Supplementary Slides

Why not model long-term trends? We could ignore the fact that the Elos are normalized and try to model the long-term trends if we wanted to.



Some Interesting Team Results

	1	2	3	4
BUF	6	9	0	0
DEN	2	4	0	9
NE	0	0	0	15
NYG	2	10	0	3