Optimal European Soccer Matches Scheduling

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15.093 Optimization – Fall 2022

Problem Statement

The goal is to optimize 5 top European soccer leagues schedule to maximize rest time. The best model has the best trade-off between performance and computation time.

We consider a single league: N=20 teams, W = N − 1 = 19 weeks (first half of the season)

"We are going to kill the players!" – Ex-PSG/Chelsea Head Coach Tuchel

"We play so much, too much …" – Tottenham/ex-Juve Head Coach Conte

- Injuries doubled over the last 20 years.
- Optimizing schedule is beneficial for players, supporters, sponsors and TV broadcasters.

Data

➤ 2022 schedules of European soccer leagues used as baseline.
➤ No other external data but required domain expertise and knowledge of soccer schedule rules.

How to solve the problem?

Mixed-integer optimization problem & multiple heuristics to make the solution scalable

General formulation

$$\min_{x} \sum_{i,j,k,w,d,d'} C_{7w+d,7(w+1)+d'} \; x_{ijwd} \; x_{ik(w+1)d'}$$

Variables:

$$x_{ijwd} = \begin{cases} 1, & \text{if i plays j on day d of week w} \\ 0, & \text{otherwise} \end{cases}$$

Parameters:

$$C_{tt'} = \begin{cases} \frac{1}{t'-t}, & \text{if t'} > \text{t} \\ 0, & \text{otherwise} \end{cases}$$

Sequence	$\frac{1}{t'-t}$	$t'-t$
(1, 3, 5)	$\frac{1}{2}+\frac{1}{2}=1$	$2+2=4$
(1, 2, 5)	$\frac{1}{1}+\frac{1}{3}=1.33$	$1+3=4$

Constraints:

- One opponent per week
- N-1 games per team
- Teams play each other once
- No games on Tuesday, Wednesday & Thursday

Different approaches

Optimal approach

Solve the optimization problem

Split teams in groups

Solve the problem for 4 groups of 5 teams

Greedy approaches
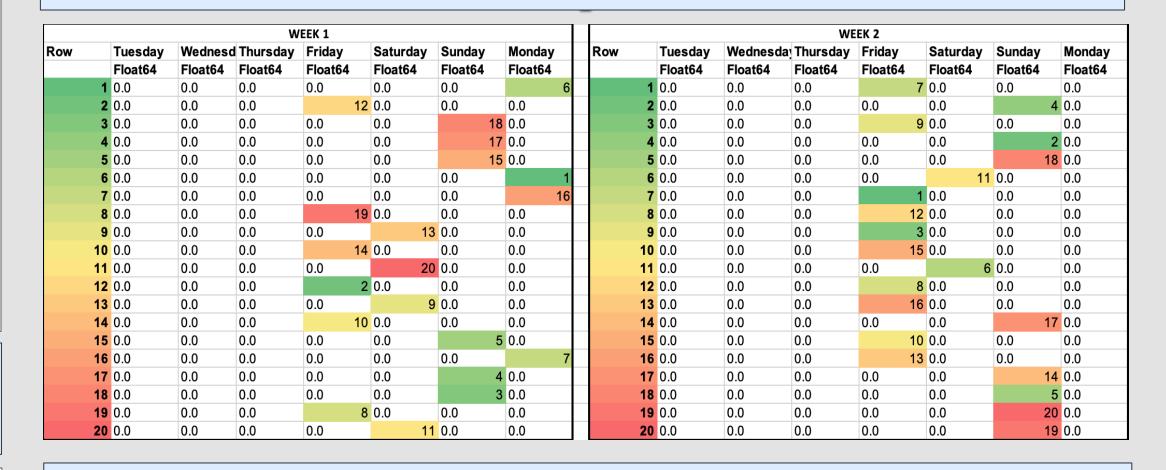
Optimize P weeks at a time and freeze the results

Greedy approaches & random restart

Re-optimize randomly subsets of weeks k times

Results and impact

Models	Objective function	Time (s)
Baseline (Real life)	55.76	/
Freeze entire period optimized (5.3)	56.95	3,084
Freeze first week of period optimized (5.4)	51.68	9,881
(5.3) + Random restart	56.20	5,373
(5.4) + Random restart	51.68	11,932
Optimal model (time limit)	51.46	21,600

- Best heuristic approach: *Freeze first week of period optimized*
  - **7.3% improvement over the baseline**
  - **54.25 % faster** with 0.3% gap to optimality

Improvements

- Consider adding international competitions and international breaks

- Consider the environmental impact of traveling
- Formulate problem at **player level** instead of team level