The flexibility of Home Away Pattern sets

Frits Spieksma (Eindhoven University of Technology (TU/e)),

joint work with Roel Lambers (TU/e) and Dries Goossens (RU Gent)

MathSport, Athens, July 3, 2019

Scheduling concerns

	1	2	3	4	5	6	7
T1: Brunssum	H	A	H	A	H	A	H
T2: GTR	H	A	A	H	A	H	A
T3: Stein 1	H	A	H	A	A	H	A
T4: Kimbria	H	A	H	A	H	A	A
T5: Simpelveld	A	H	A	H	A	H	A
T6: TC Vaals	A	H	H	A	H	A	H
T7: Kerkrade '54	A	H	A	H	H	A	H
T8: Stein 2	A	H	A	H	A	H	H

Scheduling concerns

	1	2	3	4	5	6	7
T1: Brunssum	H	A	H	A	H	A	H
T2: GTR	H	A	A	H	A	H	A
T3: Stein 1	H	A	H	A	A	H	A
T4: Kimbria	H	A	H	A	H	A	A
T5: Simpelveld	A	H	A	H	A	H	A
T6: TC Vaals	A	H	H	A	H	A	H
T7: Kerkrade '54	A	H	A	H	H	A	H
T8: Stein 2	A	H	A	H	A	H	H

What if we don't want Team 8 vs Team 3 in the last round?

Scheduling concerns

	1	2	3	4	5	6	7
T1: Brunssum	H	A	H	A	H	A	H
T2: GTR	H	A	A	H	A	H	A
T3: Stein 1	H	A	H	A	A	H	A
T4: Kimbria	H	A	H	A	H	A	A
T5: Simpelveld	A	H	A	H	A	H	A
T6: TC Vaals	A	H	H	A	H	A	H
T7: Kerkrade '54	A	H	A	H	H	A	H
T8: Stein 2	A	H	A	H	A	H	H

What if we want Team 1 vs Team 3 in the last round?

Scheduling concerns

	1	2	3	4	5	6	7
T1: Brunssum	H	A	H	A	H	A	H
T2: GTR	H	A	A	H	A	H	A
T3: Stein 1	H	A	H	A	A	H	A
T4: Kimbria	H	A	H	A	H	A	A
T5: Simpelveld	A	H	A	H	A	H	A
T6: TC Vaals	A	H	H	A	H	A	H
T7: Kerkrade '54	A	H	A	H	H	A	H
T8: Stein 2	A	H	A	H	A	H	H

A more detailed analysis will reveal that, in any feasible schedule, the matches in the last round are:

T1 vs T2, T6 vs T5, T7 vs T4, T8 vs T3

There is no *flexibility* for these matches

Goal (pun intended) of this presentation

- To investigate the notion of flexibility of a Home Away Pattern-set (a HAP-set)

Overview of this presentation

- Prologue
- Measures of flexibility
- The Canonical Pattern Set
- Computing the measures
- The end

The setting

- A Single Round Robin, i.e., each pair of teams meets once.
- We let 2n denote the number of teams
- Thus, there are 2n-1 rounds, each round consisting of n matches
- Each team has a home venue, and each pair of teams meets once, either in the one teams‘s home venue, or in the other team‘s home venue

Terminology

- If a team has two consecutive home games, or two consecutive away games in rounds r and r+1, we say that the team has a *break* in round r+1.

- If a team has one break or less, its HAP is called *single break;* if all HAPs in the HAP-set H are single break, H is called a single break HAP-set.

- Two teams have complementary HAPs, H and H^c, when they never play both home or both away in the same round. If, for all H in H, Hc in H, H is a *complementary* HAPset.

Facts

- FACT: All single break HAP-sets are complementary
- FACT: All single break HAP-sets have breaks in n-1 or n different rounds
- We can characterize any single break HAP-set H by specifying the rounds in $\{r_1, \ldots, r_{2n-1}\}$ in which the breaks occur.

A popular approach to find a schedule

- First-Break-Then Schedule (FBTS)

- When using FBTS, the challenge to find a schedule is decomposed into two problems: (i) decide upon a HAP for each team, (ii) given the resulting HAP-set, decide upon the round for each match (in accordance with the HAPs of course). (see Rasmussen and Trick, 2008)

- This gives us a *schedule*: for each match i vs j, it is specified in which round it takes place

- What HAP-set is very often used?

A very popular HAP set: the Canonical Pattern Set

- In practice, a very popular HAP-set is the co-called Canonical Pattern Set (CPS), a single break HAP-set with breaks in rounds 3, 5, …, 2n-1.

	1	2	3	4	5	6	7
Team 1	H	A	H	A	H	A	H
Team 2	H	A	A	H	A	H	A
Team 3	H	A	H	A	A	H	A
Team 4	H	A	H	A	H	A	A
Team 5	A	H	A	H	A	H	A
Team 6	A	H	H	A	H	A	H
Team 7	A	H	A	H	H	A	H
Team 8	A	H	A	H	A	H	H

Not all HAP-sets are created equal

- First-Break-Then-Schedule: the diversity of the set of schedules that is compatible with a HAP-set is relevant.

- Our questions: how flexible is CPS? Can we choose our HAP-set, while maximizing flexibility for scheduling individual matches?

- Clearly, two schedules both compatible with the same HAP-set are *distinct* when there exists a match that is played in one round in schedule 1 and in another round in schedule 2.

A stronger notion of distinctness:

- Two schedules, each compatible with a given HAP-set H, are *match-distinct*

  when each match is played in a different round (when comparing schedule 1 with schedule 2).

The flexibility of a HAP-set: a first measure

- Measure 1: The *width* of a HAP-set H is the maximum number of pairwise match-distinct schedules compatible with it.

Measure 1: the width

- Theorem: width(CPS(2n)) = 1.

Measure 1: the width

- Theorem: width(CPS(2n)) = 1. Moreover, every feasible single-break HAP-set has width 1.

The width: an example

Team	HAP
1	HAH
2	HAA
3	AHA
4	AHH

Team	HAP
1	HHH
2	HAA
3	AHA
4	AAH

Round	Sol1	Sol2
1	(1,3),(2,4)	(1,4),(2,3)
2	(4,1),(3,2)	(3,1),(4,2)
3	(1,2),(4,3)	(1,2),(4,3)

Round	Sol1	Sol2
1	(1,3),(2,4)	(1,4),(2,3)
2	(4,1),(3,2)	(1,2),(3,4)
3	(1,2),(4,3)	(1,3),(4,2)

CPS(4) has width 1

This HAP-set has width 2
(but is not single break)

Measure 2: the absolute fixed part

- Measure 2: the *absolute fixed part (AFP)* of a HAP-set is the number of matches that are played in the same round in every schedule compatible with H.

- Remark: a HAP-set with width ≥ 2 has AFP $= 0$

Measure 2: the absolute fixed part

- Measure 2: the *absolute fixed part (AFP)* of a HAP-set is the number of matches that are played in the same round in every schedule compatible with H.

- Remark: a HAP-set with width ≥ 2 has AFP $= 0$

- Theorem: (i) AFP(CPS(2n)) = n,

Measure 2: the absolute fixed part

- Measure 2: the *absolute fixed part (AFP)* of a HAP-set is the number of matches that are played in the same round in every schedule compatible with H.

- Remark: a HAP-set with width ≥ 2 has AFP $= 0$

- Theorem: (i) AFP(CPS(2n)) = n, (ii) There exist single break HAP-sets H with AFP(H) = 4, for each $n \geq 4$, and this is tight.

Measure 2: the absolute fixed part

- Measure 2: the *absolute fixed part (AFP)* of a HAP-set is the number of matches that are played in the same round in every schedule compatible with H.

- Remark: a HAP-set with width ≥ 2 has AFP $= 0$

- Theorem: (i) AFP(CPS(2n)) = n, (ii) There exist single break HAP-sets H with AFP(H) = 4, for each $n \geq 4$, and this is tight.

- Remark: In the CPS, the matches that are fixed all need to be played in the same round.

Measure 3: the spread

Definition: the spread of a match (i,j) wrt to HAP-set H, is the number of distinct rounds in which it can be played in any feasible schedule compatible with H

- Measure 3: the *spread* of a HAP-set is the sum, over the matches, of the spread of a match

Measure 3: the spread

Definition: the spread of a match (i,j) wrt to HAP-set H, is the number of distinct rounds in which it can be played in any feasible schedule compatible with H

- Measure 3: the *spread* of a HAP-set is the sum, over the matches, of the spread of a match

- Theorem: $\text{spread}(CPS(2n)) = n/6\ (10n^2 - 9n + 11) - \lceil n/2 \rceil$

Flexibility measures: the numbers

CPS versus single break HAP-set

2n	Spread(CPS)	Spread(*)	AFP(CPS)	AFP(*)
4	**10**	**10**	**2**	**2**
6	**35**	**35**	**3**	**3**
8	**88**	**88**	**4**	**4**
10	**177**	**177**	5	**4**
12	314	**332**	6	**4**
14	507	**557**	7	**4**
16	768	**864**	8	**4**

Numbers in bold indicate the best score on the respective measure, "*" indicates the single break HAP-set that scores best

Intermezzo: Computing the flexibility

- Consider the following integer program based on binary variables $x_{m,r}$, ($y_{m,r}$) that indicate whether match m, in schedule 1 (2), is played in round r. Also, we have binary variables $z_{m,r}$.

- The model:

minimize $\Sigma_m \Sigma_r z_{m,r}$

subject to

x is a feasible schedule,

y is a feasible schedule,

$x_{m,r} + y_{m,r} \leq 1 + z_{m,r}$ for each match m, round r

integrality constraints

Computing the flexibility of a HAP-set

- Using this IP, we can compute our measures.

- Indeed, the objective function models directly models the AFP (and if its value equals 0, we have width ≥ 2).

A first conclusion

- The CPS is not a flexible HAP-set; indeed when using First-Break-Then-Schedule, there are better single break HAP sets.

- Using more breaks allows more flexibility.

- Is there nothing good about the CPS?

Properties of a Home Away Pattern (theory)

- Let's look at properties of an individual HAP
- Balancing the home and away matches over time.
- Definition: A HAP is {p,q}-balanced if the number of H's, as well as the number of A's between (and including) round p and round q ($p < q$) is in:

$$\{\text{rounddown}((q-p+1)/2), \text{roundup}((q-p+1)/2)\}$$

Properties of a Home Away Pattern (theory)

Let‘s look at properties of an individual HAP

- Definition: A HAP is {p,q}-balanced if the number of H’s, as well as the number of A’s between (and including) round p and round q ($p < q$) is in:

{rounddown((q-p+1)/2), roundup((q-p+1)/2))}

- By plugging in specific values for p and q we find some usual conditions

Properties of a Home Away Pattern (theory)

Balancing properties

- *Basic:* this means that each team plays exactly n-1 times home, and n-1 times away. This happens when p=1, q=2n-2.
- *Regular:* this means no three consective A's or H's. This happens when q=p+2, for each p.
- *Half-balanced*: this means that each team plays either rounddown((n-1)/2) times home, or roundup((n-1)/2) times in the first half of the DRR. This happens when p=1, q=n-1.
- *Short-balanced*: this means that each team starts and ends with a home and an away match. This happens for (p,q) in {(1,2), (2n-2, 2n-1)}.
- *End-balanced*: this means that, in the last four rounds, each team plays twice at home, and twice away. This happens when p=2n-5, q=2n-2.

Properties of a Home Away Pattern (theory)

Other properties

- *Symmetric:* this means that there is an ‘A‘ in round i iff there is an ‘H‘ in round n-1+i.
- *Nice*: this means that there are no 4 ‘A‘s (nor 4 ‘H‘s) in any sequence of 5 consecutive matches.
- *British*: this means that each break occurs in an odd round.

Properties of HAP-sets (practice)

	# teams	#breaks	Equi-break?	# Compl pairs
PL	20	148	{5,6,7,8,9,10}	all
L1	20	66	{2,3,4}	0
SA	20	72	{3,4}	7
PD	20	54	{0,3}	all
BL	18	48	{0,3}	all

Clearly, breaks are not considered too important in the Premier League.

About the Premier League's HAP-set

ROUNDS	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19
TEAMS (20)																			
Arsenal	H	A	A	H	A	H	H	A	A	H	A	H	A	H	H	A	A	H	H
Bournemouth	A	H	H	A	H	A	H	A	A	H	A	H	A	H	H	A	A	H	A
Brighton	H	A	A	H	A	H	A	H	A	H	A	H	A	H	H	A	A	H	H
Burnley	A	H	A	H	A	H	A	H	A	H	A	H	H	A	A	H	H	A	H
Chelsea	H	A	H	A	H	A	H	A	H	A	H	A	A	H	H	A	A	H	A
Crystal Palace	H	A	H	A	H	A	A	H	A	H	A	H	H	A	A	H	H	A	A
Everton	H	A	A	H	A	H	H	A	H	A	H	A	A	H	H	A	A	H	H
Huddersfield	A	H	H	A	H	A	H	A	H	A	H	A	H	A	A	H	H	A	A
Leicester City	A	H	A	H	A	H	A	H	A	H	A	H	A	H	H	A	A	H	H
Liverpool	A	H	H	A	H	A	A	H	A	H	A	H	H	A	A	H	H	A	A
Manchester City	A	H	A	H	A	H	A	H	H	A	H	A	A	H	H	A	A	H	H
Manchester United	H	A	H	A	H	A	H	A	A	H	A	H	H	A	A	H	H	A	A
Newcastle	H	A	H	A	H	A	H	A	H	A	H	A	H	A	A	H	H	A	A
Southampton	H	A	A	H	A	H	A	H	H	A	H	A	H	A	A	H	H	A	H
Stoke City	A	H	A	H	A	H	H	A	H	A	H	A	A	H	H	A	A	H	H
Swansea City	A	H	A	H	A	H	A	H	H	A	H	A	H	A	A	H	H	A	H
Tottenham	A	H	H	A	H	A	A	H	H	A	H	A	H	A	A	H	H	A	A
Watford	H	A	H	A	H	A	A	H	A	H	A	H	A	H	H	A	A	H	A
West Bromwich Albion	H	A	H	A	H	A	H	A	A	H	A	H	A	H	H	A	A	H	A
West Ham United	A	H	A	H	A	H	H	A	H	A	H	A	H	A	A	H	H	A	H

ROUNDS	R20	R21	R22	R23	R24	R25	R26	R27	R28	R29	R30	R31	R32	R33	R34	R35	R36	R37	R38
TEAMS (20)																			
Arsenal	A	A	H	A	H	A	H	A	H	A	H	A	H	H	A	H	A	H	A
Bournemouth	H	H	A	H	A	A	H	A	H	A	H	H	A	H	A	H	A	H	A
Brighton	A	A	H	A	H	A	H	A	H	H	A	A	H	H	A	H	A	H	A
Burnley	A	A	H	A	H	A	H	A	H	H	A	H	A	A	H	A	H	A	H
Chelsea	H	H	A	H	A	H	A	H	A	A	H	A	H	H	A	H	A	H	A
Crystal Palace	H	H	A	H	A	A	H	A	H	H	A	A	H	A	H	A	H	A	H
Everton	A	A	H	A	H	H	A	H	A	A	H	A	H	H	A	H	A	H	A
Huddersfield	H	H	A	H	A	H	A	H	A	A	H	H	A	A	H	A	H	A	H
Leicester City	A	A	H	A	H	A	H	A	H	H	A	H	A	H	A	H	A	H	A
Liverpool	H	H	A	H	A	A	H	A	H	H	A	H	A	A	H	A	H	A	H
Manchester City	A	A	H	A	H	H	A	H	A	H	A	H	A	H	A	H	A	H	A
Manchester United	H	H	A	H	A	A	H	A	H	A	H	A	H	A	H	A	H	A	H
Newcastle	H	H	A	H	A	H	A	H	A	A	H	A	H	A	H	A	H	A	H
Southampton	A	A	H	A	H	H	A	H	A	H	A	H	A	A	H	A	H	A	H
Stoke City	A	A	H	A	H	H	A	H	A	A	H	H	A	H	A	H	A	H	A
Swansea City	A	A	H	A	H	H	A	H	A	H	A	H	A	A	H	A	H	A	H
Tottenham	H	H	A	H	A	H	A	H	A	H	A	H	A	A	H	A	H	A	H
Watford	H	H	A	H	A	A	H	A	H	H	A	A	H	H	A	H	A	H	A
West Bromwich Albion	H	H	A	H	A	A	H	A	H	A	H	A	H	H	A	H	A	H	A
West Ham United	A	A	H	A	H	H	A	H	A	A	H	H	A	A	H	A	H	A	H

Fact 1: for each team, home breaks and away breaks alternate

Fact 2: each pattern is british, i.e., a break always occurs in an odd round, as in the CPS!

About the Premier League's HAP-set

ROUNDS	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21	R22	R23	R24	R25	R26	R27	R28	R29	R30	R31	R32	R33	R34	R35	R36	R37	R38
TEAMS (20)																																						
Arsenal	H	A	A	H	A	H	H	A	A	H	A	H	A	H	H	A	A	H	H	A	A	H	A	H	A	H	A	H	A	H	A	H	H	A	H	A	H	A
Bournemouth	A	H	H	A	H	A	H	A	A	H	A	H	A	H	H	A	A	H	A	H	H	A	H	A	A	H	A	H	A	H	H	A	H	A	H	A	H	A
Brighton	H	A	A	H	A	H	A	H	A	H	A	H	A	H	H	A	A	H	H	A	A	H	A	H	A	H	A	H	H	A	A	H	H	A	H	A	H	A
Burnley	A	H	A	H	A	H	A	H	A	H	A	H	H	A	A	H	H	A	H	A	A	H	A	H	A	H	A	H	H	A	H	A	A	H	A	H	A	H
Chelsea	H	A	H	A	H	A	H	A	H	A	H	A	A	H	H	A	A	H	A	H	H	A	H	A	H	A	H	A	A	H	A	H	H	A	H	A	H	A
Crystal Palace	H	A	H	A	H	A	A	H	A	H	A	H	H	A	A	H	H	A	A	H	H	A	H	A	A	H	A	H	H	A	A	H	A	H	A	H	A	H
Everton	H	A	A	H	A	H	H	A	H	A	H	A	A	H	H	A	A	H	H	A	A	H	A	H	H	A	H	A	A	H	A	H	H	A	H	A	H	A
Huddersfield	A	H	H	A	H	A	H	A	H	A	H	A	H	A	A	H	H	A	A	H	H	A	H	A	H	A	H	A	A	H	H	A	A	H	A	H	A	H
Leicester City	A	H	A	H	A	H	A	H	A	H	A	H	A	H	H	A	A	H	H	A	A	H	A	H	A	H	A	H	H	A	H	A	H	A	H	A	H	A
Liverpool	A	H	H	A	H	A	A	H	A	H	A	H	H	A	A	H	H	A	A	H	H	A	H	A	A	H	A	H	H	A	H	A	A	H	A	H	A	H
Manchester City	A	H	A	H	A	H	A	H	H	A	H	A	A	H	H	A	A	H	H	A	A	H	A	H	H	A	H	A	H	A	H	A	H	A	H	A	H	A
Manchester United	H	A	H	A	H	A	H	A	A	H	A	H	H	A	A	H	H	A	A	H	H	A	H	A	A	H	A	H	A	H	A	H	A	H	A	H	A	H
Newcastle	H	A	H	A	H	A	H	A	H	A	H	A	H	A	A	H	H	A	A	H	H	A	H	A	H	A	H	A	A	H	A	H	A	H	A	H	A	H
Southampton	H	A	A	H	A	H	A	H	H	A	H	A	H	A	A	H	H	A	H	A	A	H	A	H	H	A	H	A	H	A	A	H	A	H	A	H	A	H
Stoke City	A	H	A	H	A	H	H	A	H	A	H	A	A	H	H	A	A	H	H	A	A	H	A	H	H	A	H	A	A	H	H	A	H	A	H	A	H	A
Swansea City	A	H	A	H	A	H	A	H	H	A	H	A	H	A	A	H	H	A	H	A	A	H	A	H	H	A	H	A	H	A	H	A	A	H	A	H	A	H
Tottenham	A	H	H	A	H	A	A	H	H	A	H	A	H	A	A	H	H	A	A	H	H	A	H	A	H	A	H	A	H	A	H	A	A	H	A	H	A	H
Watford	H	A	H	A	H	A	A	H	A	H	A	H	A	H	H	A	A	H	A	H	H	A	H	A	A	H	A	H	H	A	A	H	H	A	H	A	H	A
West Bromwich Albion	H	A	H	A	H	A	H	A	A	H	A	H	A	H	H	A	A	H	A	H	H	A	H	A	A	H	A	H	A	H	A	H	H	A	H	A	H	A
West Ham United	A	H	A	H	A	H	H	A	H	A	H	A	H	A	A	H	H	A	H	A	A	H	A	H	H	A	H	A	A	H	H	A	A	H	A	H	A	H

Fact 1: for each team, home breaks and away breaks alternate

Fact 2: each pattern is british, i.e., a break always occurs in an odd round, as in the CPS!

These two facts together imply that, after each even number of rounds each team has played as many home matches as away matches. The schedule is *ranking balanced.* No other league we know has this property.

The end

Thanks!

Properties of a Home Away Pattern (theory)

Basic	(1,2n-2)
Regular	(p,p+2)
Half-Balanced	(1, n-1)
Short-Balanced	(1,2) and (2n-2, 2n-1)
End-Balanced	(2n-5,2n-2)
Symmetric	
Nice	
British	

Properties of a Home Away Pattern (theory)

Basic	(1,2n-2)
Regular	(p,p+2)
Half-Balanced	(1, n-1)
Short-Balanced	(1,2) and (2n-2, 2n-1)
End-Balanced	(2n-5,2n-2)
Symmetric	
Nice	
British	

Normal means basic, regular, half-balanced, short-balanced.

Properties of a Home Away Pattern (theory)

Basic	(1,2n-2)
Regular	(p,p+2)
Half-Balanced	(1,n-1)
Short-Balanced	(1,2) and (2n-2, 2n-1)
End-Balanced	(2n-5,2n-2)
Symmetric	
Nice	
British	

Normal means basic, regular, half-balanced, short-balanced.
Perfect means normal, end-balanced, symmetric, nice

Properties of Patterns (practice)

	# teams	Basic	Regular	Short-bal	Half-bal	End-bal	Symm	Nice	British
PL	20	Y	Y	Y	Y	Y	N	Y	Y
L1	20	Y	Y	Y	Y	N	N	N	N
SA	20	Y	Y	N	Y	Y	Y	Y	N
PD	20	Y	Y	Y	Y	N	Y	N	N
BL	18	Y	Y	Y	Y	Y	Y	N	N

Concerning Serie A: Cagliari starts with two away matches, while Crotone starts with two home matches. This makes this pattern-set not short-balanced, and hence not normal.

Properties of Patterns (practice)

	# teams	Basic	Regular	Short-bal	Half-bal	End-bal	Symm	Nice	British
PL	20	Y	Y	Y	Y	Y	N	Y	Y
L1	20	Y	Y	Y	Y	N	N	N	N
SA	20	Y	Y	N	Y	Y	Y	Y	N
PD	20	Y	Y	Y	Y	N	Y	N	N
BL	18	Y	Y	Y	Y	Y	Y	N	N

Concerning Ligue 1: the teams called En Avant de Guingamp, and OGC Nice each play three times away in their last four matches, while Stade Rennais and Olympique Lyonnais each play home three times in their last four matches. Moreover, LOSC Lille plays four times away in five consecutive matches.

Properties of Patterns (practice)

	# teams	Basic	Regular	Short-bal	Half-bal	End-bal	Symm	Nice	British
PL	20	Y	Y	Y	Y	Y	N	Y	Y
L1	20	Y	Y	Y	Y	N	N	N	N
SA	20	Y	Y	N	Y	Y	Y	Y	N
PD	20	Y	Y	Y	Y	N	Y	N	N
BL	18	Y	Y	Y	Y	Y	Y	N	N

Concerning Primera Division: the team Athletic plays three times away in its last four matches, while Malaga plays home three times in their last four matches. Also, Malaga plays away four times in five consecutive matches, rendering its pattern not nice (and indeed Atletic plays home four times in five consecutive matches).

Properties of Patterns (practice)

	# teams	Basic	Regular	Short-bal	Half-bal	End-bal	Symm	Nice	British
PL	20	Y	Y	Y	Y	Y	N	Y	Y
L1	20	Y	Y	Y	Y	N	N	N	N
SA	20	Y	Y	N	Y	Y	Y	Y	N
PD	20	Y	Y	Y	Y	N	Y	N	N
BL	18	Y	Y	Y	Y	Y	Y	N	N

Concerning Bundesliga: TSG Hoffenheim plays away four times in five consecutive matches

Properties of Patterns (practice)

We look at the Premier League (PL), Ligue 1 (L1), Serie A (SA), Primera Division (PD), and the Bundesliga (BL); season 2017-2018 (except PD: season 2016-2017).

	# teams	Basic	Regular	Short-bal	Half-bal	End-bal	Symm	Nice	British
PL	20	Y	Y	Y	Y	Y	N	Y	Y
L1	20	Y	Y	Y	Y	N	N	N	N
SA	20	Y	Y	N	Y	Y	Y	Y	N
PD	20	Y	Y	Y	Y	N	Y	N	N
BL	18	Y	Y	Y	Y	Y	Y	N	N