DO RED CARDS LEAD TO MORE GOALS?

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We analysed 19,294 matches across 10 European competitions spanning 5 seasons. Despite our usual caution in drawing definitive conclusions as data scientists, it appears that red cards generally lead to an increase in goals, based on this data. We note that games with and without red cards both have the same average goals per game of **2.61**, but that for matches with red cards, the red card does seem to lead to more goals per minute after the sanction is awarded.

On average, matches with red cards saw **1.61** goals before and **1.00** goals after the red card, suggesting a decrease in scoring rates post-red card. However, a closer look revealed that the rate of **goals per 10 minutes** surged from **0.29** to **0.76** after a red card, indicating a significant spike in goal-scoring activity within a shorter time frame. Red cards tend to happen later in the game, which could help explain this.

Serie A exhibited the most pronounced differences in goal-scoring rates per team post-red card, while **Bundesliga** and **Ligue 1** teams showed the weakest performance after receiving a red card. Contrary to the notion that '10 men do it better', we found that, in general, they scored fewer goals than their opponents post-red card (except for one league). Additionally, we observed that **17%** of the goals occurred within 3 minutes after the red card, demonstrating a peak that may account for penalty decisions as a result of red cards.

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THE DATA

19,294 matches in 10 European competitions across 5 years (2018/19 – 2022/23 seasons).

26 discrepancies between *events.csv* and *games.csv*, to flag to data collection team (see appendix for full data cleaning details). This means a total of 19,268 matches were used in analysis.

The following table shows the number of goals and red cards for all games:

goals red_cards	0	1	2	3	4	5	6	7	8	9	10	11
5	0	6	0	0	0	10	0	0	0	0	0	0
4	0	5	0	21	16	0	10	0	0	0	0	0
3	15	16	55	90	14	32	27	0	22	12	0	0
2	52	264	424	450	384	175	200	72	0	11	0	0
1	235	1148	2391	2700	2155	1302	728	336	72	10	11	0
0	1258	2885	7904	10197	8888	5895	3000	1463	552	153	20	22

Table 1: Goals and red cards for all games

We can see **3 goals** and **0 red cards** in a game is the most common combination. There are very rare occurrences of up to **11 goals** and **5 red cards**.

SUMMARY STATISTICS

Correlation: Simple correlation of total goals to red cards in a game was **-0.04**, giving a very weak negative correlation between goals and red cards. Unsurprisingly, this will require more complex analysis.

Chances of a goal after a red card: Overall there is a **52%** chance of any goal happening after a red card. When a team receives a red card, there is a **23%** chance of the sanctioned team scoring after the red card is awarded. However, there is a **45%** chance of the other team scoring following a red card.

Proportion of goals scored after the first red card of the game: There is a **25:75** ratio of goals scored by the sanctioned team and unsanctioned team, respectively. This means only about one quarter of goals scored after a red card are scored by the sanctioned team. One could simplify this to "the opposing team scores three times as much as the sanctioned team after a red card is given".

However, what we want to know is if *red cards lead to more goals* in a match, and to do this we must compare matches with red cards to matches without red cards.

Games with/without red cards: Average goals per game without AND with red cards: **~2.61**. There was no difference in total goals scored per game when we look at the entire data set.

Table 2 shows the breakdown of average goals per games with and without red cards across all competitions. Some leagues like **Serie A** have barely any difference in average goals scored, while the biggest difference is **La Liga** with **0.18** more goals per games with red cards.

Competition	With Red Cards	Without Red Cards
1. Bundesliga, Germany	3.25	3.13
2. Bundesliga, Germany	2.84	2.95
Premier League, England	2.83	2.78
Championship, England	2.59	2.50
Ligue 1, France	2.73	2.69
Ligue 2, France	2.34	2.29
Primera, Spain	2.66	2.48
Segunda, Spain	2.20	2.21
Serie A, Italy	2.86	2.84
Serie B, Italy	2.56	2.43

Table 2: Average goals per games with and without red cards across all competitions.

What will be important to this analysis is exactly *when* a red card occurs. We could have 5 red cards in the 90th minute but it probably won't affect these league matches that we are analysing. Instead, we must look closer to when the sanction occurs.

Average goals before and after red cards: In matches where a red card occurs, there is on average **1.61** goals before the red card, and **1.00** goals afterwards (we said goals in the same minute as red cards were "after" the red card as it was likely penalty/free kicks that led to goals). However, we must keep in mind that red cards can often occur later in the game and so it's simply less likely goals will occur in a short time. Indeed, recent statistics show that in the **English Premier League**, around **45%** of goals come before half time and **55%** afterwards. (source)

As such, we must investigate when the red card occurs, and compare different stages of the game when we have red cards vs when we don't have red cards.

PROBABILITY OF A RED CARD

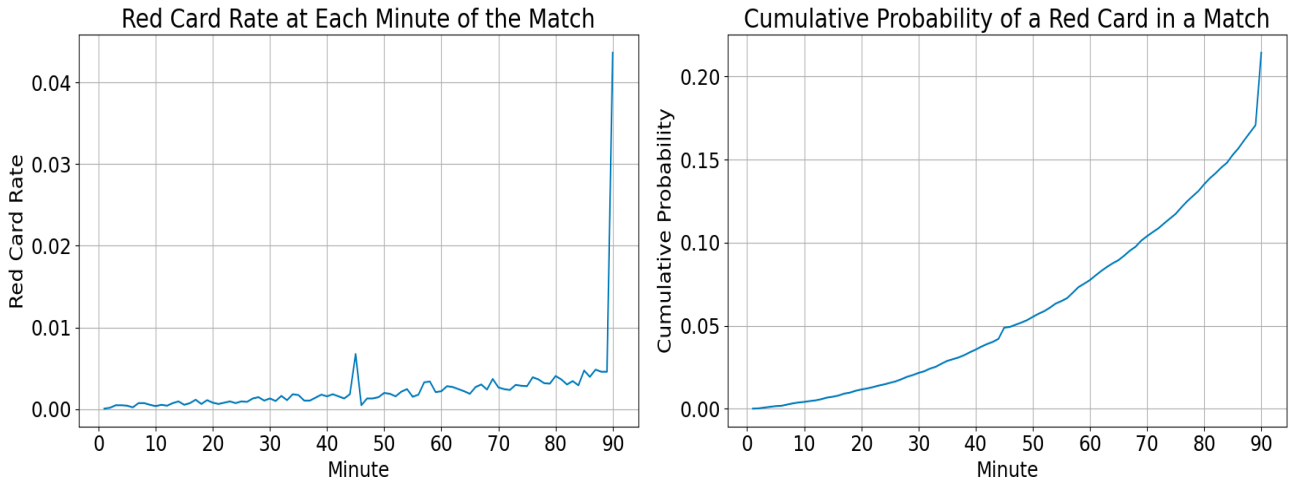


Fig.1: Red card imposing rate and cumulative red card probability.

Fig.1 shows how likely a red card is to happen at each minute of the game, as well as the cumulative probability of receiving a red card in a game. There are peaks at **45** and **90** minutes due to injury-time events extending over several minutes. We can also see an increase as we get later into the second half. This will help inform our understanding of red cards and if they lead to more goals.

Fig.2 shows the likelihood of a goal at each minute of the game, with curves for games both with and without red cards. We can see that the likelihood of a goal is slightly higher for games with red cards, and that this difference is bigger around 30 minutes, and later in the game.

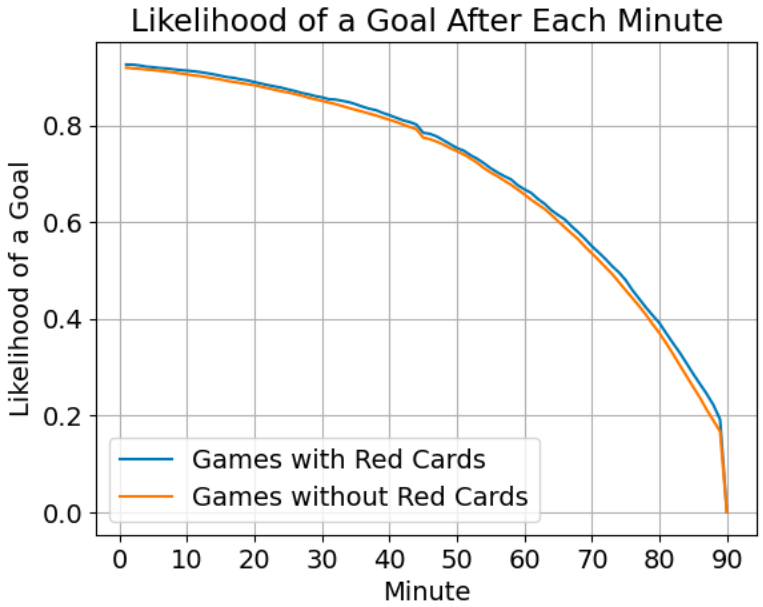


Fig.2: Likelihood of a goal at each minute of a game

RATE OF GOALS PER 10 MINUTES

We know on average there are less goals after a red card awarded, but we also know red cards are more common in the latter stages of a game. Therefore, it's useful to see how many goals are scored in terms of rate per minute, which we have simply multiplied by 10 to give **goals per 10 minutes** which is a more intuitive metric.

Mean goals per 10 minutes (***g/10m***) in games with no red cards is **0.29** (and same for all games overall). In games with red cards, the rate of goals per 10 minutes is **0.24** up until the first red card; however, after a red card, this number increases dramatically to **0.76**. The rate of scoring *more than triples* after a red card is awarded. This is strong evidence that red cards lead to more goals. Let's break this down by competition, and whether it affects the rate of scoring of the sanctioned team or the opposing team.

COMPETITION

We will focus on games with red cards only, as goals per game (per 90 minutes) without red cards are detailed in *table 2* and scoring rate can be easily extrapolated.

Table 3 shows the breakdown per competition. All competitions increase in rate after red cards. **Serie A** has the most dramatic **difference** in rates of goals of **0.78 *g/10m***, which is possibly related to it also having the latest average minute of red cards. Since red cards are often so late, when a goal is scored after in this shorter amount of time, the rate is increased. Conversely in the **Premier League**, red cards are awarded earlier, on average 60 minutes into the game, and the rate difference is lower, at only **0.32 *g/10m***.

Competition	Rate Before Red	Rate After Red	Difference	Average Minute of Red Cards
1. Bundesliga, Germany	0.30	0.76	0.46	63
2. Bundesliga, Germany	0.26	0.96	0.70	65
Premier League, England	0.27	0.59	0.32	60
Championship, England	0.24	0.75	0.51	64
Ligue 1, France	0.25	0.63	0.38	62
Ligue 2, France	0.21	0.55	0.34	63
Primera, Spain	0.26	0.71	0.45	71
Segunda, Spain	0.20	0.72	0.52	67
Serie A, Italy	0.28	1.06	0.78	71
Serie B, Italy	0.23	0.89	0.66	68

Table 3: Goals per 10 minutes before and after red cards, split by competition. Difference is also given, and the average time red cards are awarded in each league.

SANCTIONED TEAM VS OPPONENTS

The average goals scored by a sanctioned team *after* a red card is **0.26 goals**, whereas there are an average **0.74 goals** scored by the opposite team. Note this is total goals scored, not scoring rate, which is given below.

Overall, the rate of scoring is **0.29 *g/10m*** on average for all teams across all games. However, when a red card is awarded, the rate of scoring for the sanctioned team decreases to **0.21 *g/10m***, and the rate of scoring for the non-sanctioned team surges to **0.55 *g/10m***. We can see that the "10 men do it better" rule is not ringing true from our data.

Here is the breakdown by competition, to see how teams in different leagues react to a red card.

Competition	Santioned Team Rate	Non Sanctioned Team Rate
1. Bundesliga, Germany	0.12	0.64
2. Bundesliga, Germany	0.21	0.75
Championship, England	0.40	0.35
Ligue 1, France	0.12	0.51
Ligue 2, France	0.15	0.40
Premier League, England	0.17	0.43
Primera, Spain	0.19	0.52
Segunda, Spain	0.16	0.56
Serie A, Italy	0.30	0.77
Serie B, Italy	0.26	0.63

Table 4: Rate of scoring (goals per 10 minutes) by a team AFTER the first red card occurs (sanctioned team refers to first red card given).

It appears that **Bundesliga** and **Ligue 1** teams perform worst after being sanctioned. There is an interesting anomaly in the **English Championship**, wherein sanctioned teams have a higher rate of scoring after being sanctioned than their opponents. **Bundesliga 2** and **Serie A** teams have the highest scoring rate of non-sanctioned teams, who seem to take advantage of their extra man.

COULD INCREASED GOALS BE DUE TO PENALTIES?

Red cards are often given for 'last-man-back' fouls in the box and obstructing 'clear goalscoring opportunities' that could result in penalty kicks (source). Penalties have an xG of 0.8, so it's possible that these red cards lead to penalties lead to goals. We analysed 3 minutes after the red cards as a reasonable time between the commotion following a red card and the subsequent penalty. **17.5%** of the goals after red cards happened in the 3 minutes after the first red card was given. (3586 goals scored after red cards, 626 scored within 3 minutes of the red card). So, the majority of goals don't come directly after the red card, but this is a large proportion of the overall goals scored after red cards.

The difference in minutes between the red card and subsequent goals has an exponential-type distribution with a significant peak, probably coming from penalty decisions:

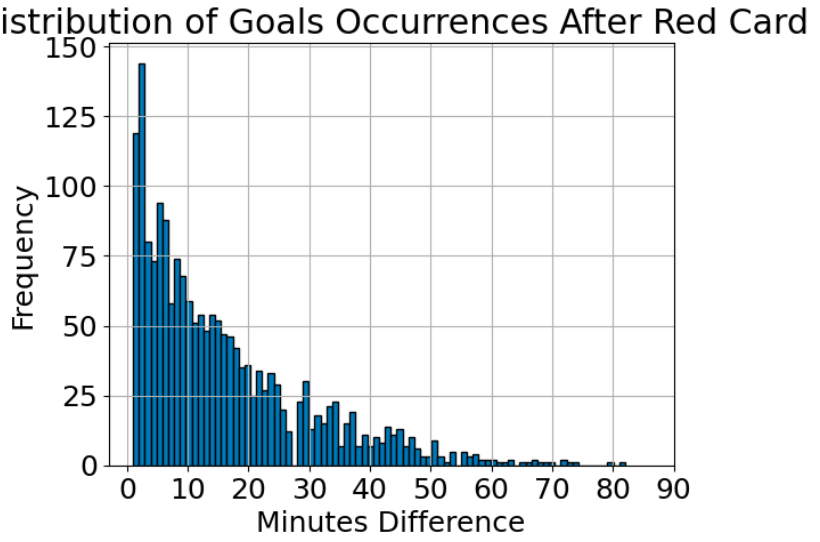


Figure 3: Distribution of goal occurrences after red card features a peak at 0-1 minutes.

CONCLUSIONS

Overall, it appears that red cards to lead to more goals. The rate of scoring increases on average three-fold, up to nearly **0.8 goals per 10 minutes** on average. The "10 men do it better" saying is a myth, and the rate of scoring by sanctioned teams decreases after a red card, whereas their opponents rate of scoring increases dramatically. However, in the **English Championship**, the rate of scoring by sanctioned team does increase, even higher than the increase in scoring by their opponents, on average. So red-carded teams in this league do have a higher chance of scoring. The rate is still low however, when compared to other leagues (**0.40 goals per 10 minutes** in sanctioned **Championship** teams, vs **0.77 goals per 10 minutes** in non-sanctioned **Serie A** teams).

Note: This analysis excluded study of multiple red cards, as less than 3% of the games in the data had 2 or more red cards occur. Only the impact of the first red card was analysed in this report.

APPENDIX

DATA CLEANING

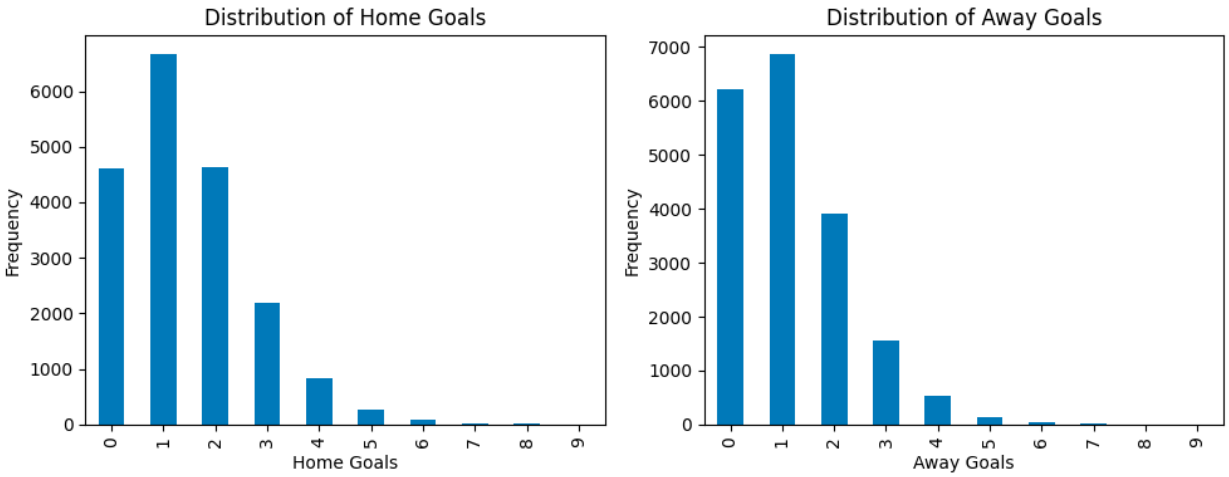
26 discrepancies in the data between goals recorded in *events.csv* and *games.csv*. Particularly in games played by Reus Deportiu in 2019 (when they went on a long 1-0 losing streak), and some others in Serie A, B, the English Championship and Ligue 2.
There was one red card in all these games (game_id 7876) but we can't see what time the goals occurred. We excluded these matches from the analysis. These events all had 1 or 3 events in *games.csv* but zero recorded in *events.csv*. Here are the discrepancies for convenience of data team investigation, which had no events recorded in the *events.csv*:

game_id	home_team	away_team	competition	date	home_goals	away_goals
321	Cosenza	Hellas Verona	Serie B, Italy	2018-09-01	0	3
2181	Albacete	Reus Deportiu	Segunda, Spain	2019-01-27	1	0
2304	Reus Deportiu	Elche	Segunda, Spain	2019-02-03	0	1
2383	Gimnastic de Tarragona	Reus Deportiu	Segunda, Spain	2019-02-09	1	0
2512	Reus Deportiu	Almería	Segunda, Spain	2019-02-17	0	1
2589	Granada	Reus Deportiu	Segunda, Spain	2019-02-24	1	0
2707	Reus Deportiu	Tenerife	Segunda, Spain	2019-03-03	0	1
2808	Lugo	Reus Deportiu	Segunda, Spain	2019-03-10	1	0
2915	Reus Deportiu	Deportivo La Coruña	Segunda, Spain	2019-03-17	0	1
2957	Extremadura	Reus Deportiu	Segunda, Spain	2019-03-24	1	0
3037	Reus Deportiu	Cádiz	Segunda, Spain	2019-03-31	0	1
3176	Mallorca	Reus Deportiu	Segunda, Spain	2019-04-07	1	0
3293	Reus Deportiu	Real Oviedo	Segunda, Spain	2019-04-14	0	1
3391	Real Zaragoza	Reus Deportiu	Segunda, Spain	2019-04-21	1	0
3471	Bolton Wanderers	Brentford	Championship, England	2019-04-27	0	1
3505	Reus Deportiu	Alcorcón	Segunda, Spain	2019-04-28	0	1
3615	Cordoba	Reus Deportiu	Segunda, Spain	2019-05-05	1	0
3711	Osasuna	Reus Deportiu	Segunda, Spain	2019-05-12	1	0
3797	Reus Deportiu	Málaga	Segunda, Spain	2019-05-19	0	1
3838	Numancia	Reus Deportiu	Segunda, Spain	2019-05-26	1	0
3849	Reus Deportiu	Sporting Gijón	Segunda, Spain	2019-06-02	0	1
3859	CF Rayo Majadahonda	Reus Deportiu	Segunda, Spain	2019-06-08	1	0
7700	Hellas Verona	Roma	Serie A, Italy	2020-09-19	3	0
7876	Alcorcón	Real Zaragoza	Segunda, Spain	2020-10-03	0	3
8270	Salernitana	AC Reggiana 1919	Serie B, Italy	2020-10-31	3	0
9111	Niort	Valenciennes	Ligue 2, France	2020-12-22	0	3

Appendix Fig 1: List of games.csv rows with no corresponding event in events.csv.

Further data cleaning revealed no missing values, though some duplicate rows existed. These were investigated and simply revealed that an event occurred twice in the same minute. These were always either two goals in injury time (45 or 90), or 2 red cards in the same minute of normal time. This only occurred 3 times, but 2 of them were coincidentally on the same day in April 2016, in different leagues, which you can see in the code section 2.c.

There were no significant outliers and teams scored up to 9 goals each, with the highest score in a game being 11 total goals. The distribution of goals is shown below:



Appendix Fig. 2: Distribution of home team goals and away team goals per match.

The data frames were merged using a left merge on the *games.csv*, meaning all original games are involved in analysis even with no goals or red cards involved.