

## Statistical characterisation of roller-hockey sport

### Second preliminary report

#### Introduction

A statistical research study has been carried out for traditional roller-hockey matches. For this purpose, a database with scores of games, linked with the ranking points (RP) from the competing teams (calculated on a match by match basis) has been built.

The database includes matches from both men and women's competitions, as well as official and friendly. Also, matches disputed in the home of one team, as well as matches played in neutral places, were considered for the analysis.

#### 1. Men's competitions with games played at the home of one team

For this purpose it is considered all the matches played by teams of men, where one of the teams play at its home. A total of 15001 matches are included in the database for these conditions. The matches concern different competitions, in different countries, and different seasons or years. The distribution of the matches by year, as well as the % of games won, drawn or lost by the home teams, is as follows:

Year	Number of matches	%	% victory for home team	% of draws	% victory for away team	% points for home team
Before 1998	1530	10,20	52,68	11,31	36,01	58,34
1998	4344	28,96	52,69	11,12	36,19	58,25
1999	5127	34,18	51,92	11,04	37,04	57,44
2000	4000	26,66	52,60	10,18	37,23	57,69
All matches	15001		52,40	10,86	36,76	57,83

The distribution of matches by countries is the following:

Country	Number of matches	%	% victory for home team	% of draws	% victory for away team	% points for home team
Portugal	3830	25,53	54,73	10,08	35,19	59,77
Spain	2980	19,87	50,84	13,19	35,97	57,44
France	2953	19,69	52,46	11,04	36,51	57,98
Italy	1437	9,58	51,08	12,53	36,40	57,35
Argentina	934	6,23	48,50	10,06	41,44	53,53
Switzerland	806	5,37	54,09	9,68	36,23	58,93
Germany	695	4,63	51,22	7,34	41,44	54,89
Friendly matches	276	1,84	48,91	12,68	38,41	55,25
England	273	1,82	55,68	7,69	36,63	59,53
Europe	237	1,58	54,43	9,70	35,86	59,28
Benelux	230	1,53	52,61	5,65	41,74	55,44
Chile	140	0,93	47,86	11,43	40,71	53,58
Netherlands	60	0,40	56,67	5,00	38,33	59,17
Other	150	1,00	56,00	6,74	37,26	59,37

Some conclusions may be extracted from these figures:

- for countries like Portugal, Spain, France, Italy, Switzerland, England, Netherlands and Benelux, the effect of playing at home represents a probability of victory for the home team around 57 %. It seems that the same effect is less clear for competitions held in Argentina, Chile and Germany;
- the % of draws is slightly higher in Spain and Italy (around 13 %) than in the other countries. In Germany, Netherlands, Benelux, Switzerland and England, less than 10 % of the matches finish with a draw result.

The following table characterises, for each country and year, the structure of goals marked per match:

Group	Mean of goals for home team	Standard deviation	Mean of goals for away team	Standard deviation	Mean of total goals	Standard deviation
Portugal	4,96	3,41	3,98	2,90	8,94	4,04
Spain	4,52	3,06	3,80	2,81	8,32	3,83
France	5,52	3,81	4,48	3,12	10,00	4,46
Italy	4,90	3,57	3,95	2,90	8,85	4,24
Argentina	5,53	3,57	5,03	3,34	10,55	4,55
Switzerland	5,33	3,59	4,32	2,97	9,65	4,28
Germany	5,65	4,22	4,79	3,87	10,44	4,97
Friendly matches	4,32	2,99	3,78	2,79	8,09	3,68
England	6,04	4,17	5,27	3,90	11,31	5,05
Europe	5,55	6,28	3,63	3,45	9,19	6,07
Benelux	6,40	4,12	5,58	3,37	11,99	5,00
Chile	5,21	3,15	4,85	3,65	10,06	4,45
2000	5,12	3,52	4,28	3,10	9,40	4,28
1999	5,08	3,48	4,22	3,08	9,30	4,40
1998	5,09	3,54	4,13	2,82	9,22	4,30
before 1998	5,39	4,14	4,23	2,76	9,62	4,62
All matches						

We can conclude that the structure of the average of goals marked is slightly different from country to country. So, in Spain, the average total number of goals per match (8,32) is significantly lower than for other countries. By the other hand, in Germany, Benelux, England and Argentina, in average, a greater number of goals are marked per match (more than 10).

The calculation of the various statistics for groups of matches according to the difference of ranking points (calculated by the ELO system), between the home and the away team, leads to the following table:

Lower limit	Upper limit	Average points differ.	Number of matches	% victory home	% of draws	% victory away	% points home	Average of goals home	Average of goals away	Average of total of goals	Average of differ. of goals
580		680	128	96,09	2,35	1,56	97,27	13,70	2,23	15,93	11,47
480	580	527	188	98,41	0,53	1,06	98,68	10,51	2,15	12,66	8,36
380	480	424	468	93,59	3,42	2,99	95,30	8,86	2,54	11,40	6,32
295	380	338	790	92,03	3,41	4,56	93,74	7,95	2,67	10,62	5,28
235	295	266	762	85,04	6,82	8,14	88,45	7,21	2,98	10,19	4,23
190	235	215	738	84,28	6,10	9,62	87,33	6,85	2,95	9,80	3,90
150	190	172	772	75,26	9,46	15,28	79,99	6,19	3,29	9,48	2,90
120	150	135	756	73,81	12,04	14,15	79,83	5,88	3,28	9,16	2,60
85	120	102	892	69,06	11,77	19,17	74,95	5,54	3,42	8,96	2,12
55	85	71	886	65,91	13,77	20,32	72,80	5,29	3,48	8,77	1,81
25	55	40	820	61,34	12,56	26,10	67,62	5,00	3,60	8,60	1,40
-5	25	10	910	59,34	13,96	26,70	66,32	4,99	3,70	8,69	1,29
-30	-5	-17	782	50,77	16,37	32,86	58,96	4,53	3,91	8,44	0,62
-60	-30	-45	852	47,42	16,31	36,27	55,58	4,49	3,99	8,48	0,50
-90	-60	-76	885	43,39	15,71	40,90	51,25	4,46	4,35	8,81	0,11
-120	-90	-105	827	34,58	16,93	48,49	43,05	4,02	4,66	8,68	-0,64
-155	-120	-135	761	28,78	15,77	55,45	36,67	3,74	4,68	8,42	-0,94
-195	-155	-172	780	27,56	11,54	60,90	33,33	3,66	5,15	8,81	-1,49
-240	-195	-214	730	22,19	12,60	65,21	28,49	3,47	5,34	8,81	-1,87
-300	-240	-265	779	15,79	11,94	72,27	21,76	3,19	5,75	8,94	-2,56
-380	-300	-334	739	10,28	6,23	83,49	13,40	3,14	6,28	9,42	-3,14
-480	-380	-420	482	5,60	6,85	87,55	9,03	2,80	7,52	10,32	-4,72
-580	-480	-521	205	6,83	3,90	89,27	8,78	2,46	8,12	10,58	-5,66
	-580	-693	144	3,47	0,00	96,53	3,47	2,15	9,63	11,78	-7,48

Some graphical representations of these data are:

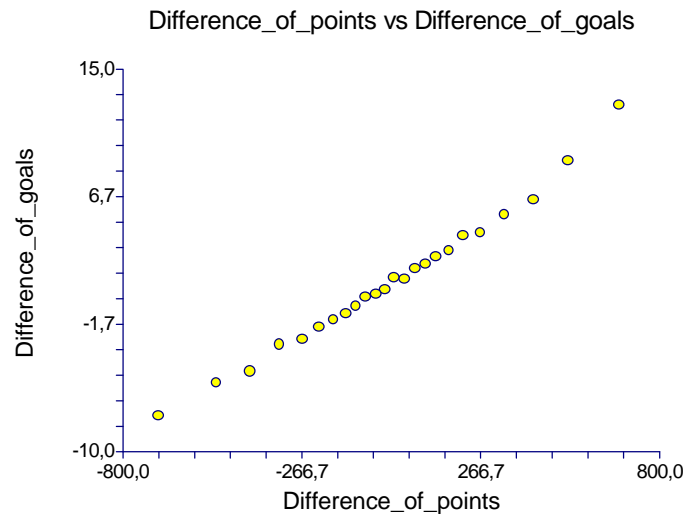


Figure 1 – Relationship between the difference of ranking points between home and away teams and the average difference of goals marked between those teams.

It is evident from Figure 1 that there is a very good correlation between the two variables. The linear regression analysis allows to the expression:

$$\text{Difference of goals} = 1,15 + 0,0140 \times (\text{Difference of ranking points})$$

with  $r^2 = 0,985$ .

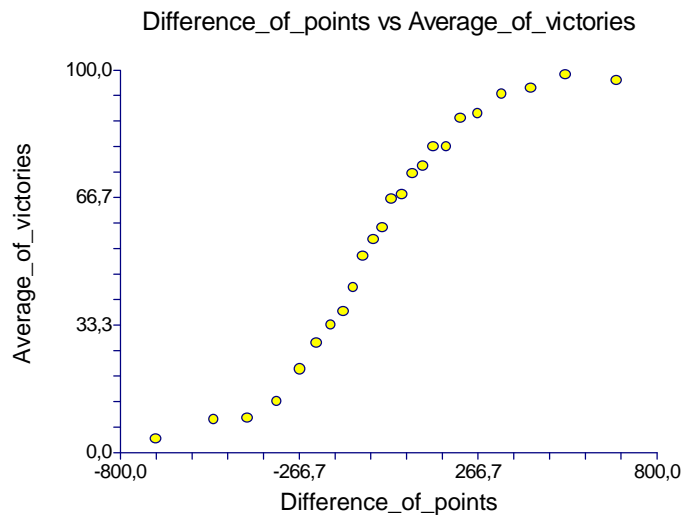


Figure 2 – Relationship between the mean of the points got by home teams and the difference of ranking points between home and away teams.

This curve is slightly different from the one employed in the ELO system, employed by FIDE (International Federation of Chess). Because of this, a modified table for the calculation of the ranking will be employed for traditional roller hockey competitions. It will be presented below.

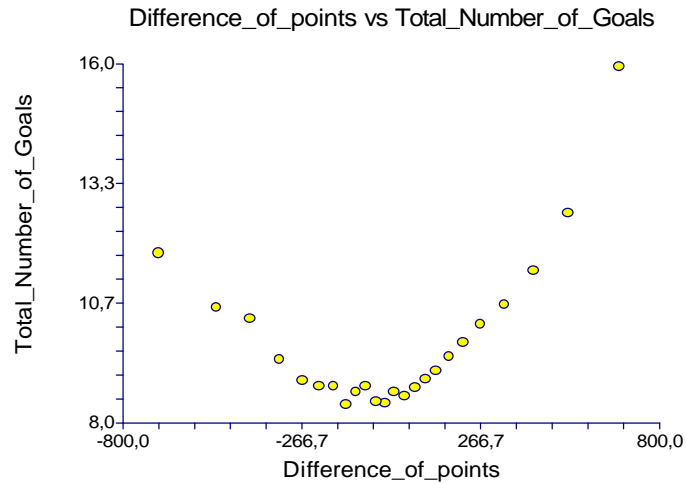


Figure 3 – Effect of the difference of ranking points between home and away teams and the average total number of goals per match.

This figure shows that the average number of goals per match is lower when the teams are of even force. When there is an important difference in the strength of the two teams, the number of goals increases accordingly. The minimum occurs for a difference of ranking points between -60 and 0 points. By the other hand, this effect is more evident when the strongest team is the one playing at home, what is also suggested by the following figure.

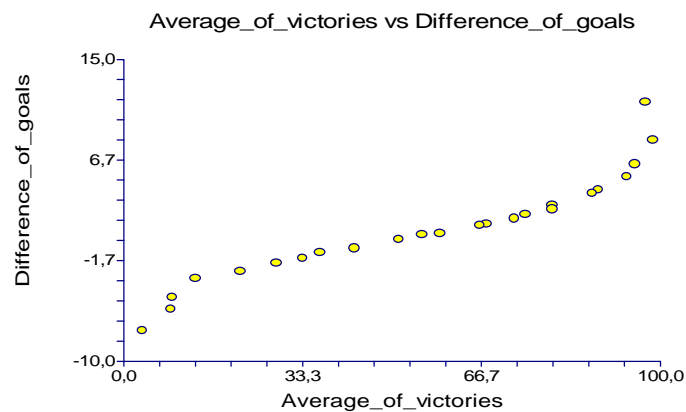


Figure 4 – Effect of the probability of victory for home team on the average difference of goals marked by the two teams.

The obtained statistics allow to calculate a modified table for the calculation of points to be won or lost by the teams, according to the difference of ranking points (RP) between the opposing teams.

RP home teams – RP away team	Home team wins	Draw	Home team loses
< - 665	+ 60	+ 30	0
≥ - 665 and < - 360	+ 55	+ 25	- 5
≥ - 360 and < - 275	+ 50	+ 20	- 10
≥ - 275 and < - 205	+ 45	+ 15	- 15
≥ - 205 and < - 140	+ 40	+ 10	- 20
≥ - 140 and < - 95	+ 35	+ 5	- 25
≥ - 95 and < - 55	+ 30	0	- 30
≥ - 55 and < - 20	+ 25	-5	-35
≥ -20 and < + 50	+ 20	- 10	- 40
≥ + 50 and < + 145	+ 15	- 15	- 45
≥ + 145 and < + 250	+ 10	- 20	- 50
≥ + 250 and < + 470	+ 5	- 25	- 55
≥ + 470	0	- 30	- 60

Change of points for home team, according to the result of the match and to the difference of ranking points (RP) between home and away team, for K = 60. The away team has a symmetrical change.

This new table will be considered for the purpose of the calculation of the men club team's ranking, in a match by match manner, after the 16 August 2000.

## 2. Women's competitions with games played at the home of one team

For this purpose it is considered all the matches played by teams of women, where one of the teams play at its home. A total of 1605 matches are included in the database for these conditions. The matches concern different competitions, in different countries, and different seasons or years. The distribution of the matches by year, as well as the % of games won, drawn or lost by home team, is as follows:

Year	Number of matches	%	% victory for home team	% of draws	% victory for away team	% points for home team
Before 1999	214	13,33	53,74	8,41	37,85	57,95
1999	755	47,04	47,95	8,08	43,97	51,99
2000	636	39,63	47,80	11,01	41,19	53,30
All matches	1605		48,66	9,28	42,06	53,30

From these figures, we may conclude that the effect of playing at home is less evident for women competition than for men.

The distribution of the considered matches by countries is the following:

Country	Number of matches	%	% victory for home team	% of draws	% victory for away team	% points for home team
Portugal	877	54,64	48,92	8,32	42,76	53,08
Spain	236	14,70	42,80	11,02	46,19	48,31
Switzerland	176	10,97	48,30	9,66	42,05	53,13
Germany	106	6,60	49,06	8,49	42,45	53,31
Argentina	83	5,17	57,83	8,43	33,73	62,04
Other	127	7,91	51,97	13,39	34,64	58,66

Some conclusions may be extracted from these figures:

- the effect of playing at home is strangely negative for the spanish competitions (48,3 %). The small number of matches considered (236) forces us to take this conclusion as yet non definitive, to be (or not) confirmed in the future;
- in average, the number of drawn matches is significantly lower than for men competitions.



The following table characterises, for each country and year, the structure of goals marked per match:

Group	Mean of goals for home team	Standard deviation	Mean of goals for away team	Standard deviation	Mean of total of goals	Standard deviation
Portugal	3,49	3,64	3,02	3,25	6,51	3,86
Spain	3,81	3,93	4,06	4,27	7,86	4,43
Switzerland	3,96	3,00	4,04	3,28	8,01	3,69
All matches	3,78	3,80	3,39	3,60	7,17	4,17

We can conclude that the structure of average of goals marked is somehow different from country to country. A great difference is clear when compared with the structure for men competitions.

The calculation of the various statistics for groups of matches according to the difference of ranking points (calculated by the ELO system), between the home and the away team, leads to the following table:

Lower limit	Upper limit	Average points differ.	Number of matches	% victory home	% of draws	% victory away	% points home	Average of goals home	Average of goals away	Average of total of goals	Average of differ. of goals
400		552	162	98,76	0,62	0,62	99,07	8,93	0,94	9,87	7,99
250	400	319	191	91,62	5,24	3,14	94,24	6,39	1,32	7,71	5,07
150	250	202	160	80,62	9,38	10,00	85,31	4,76	1,71	6,47	3,05
50	150	98	191	57,59	16,23	26,18	65,71	3,77	2,40	6,17	1,37
-30	50	11	152	56,58	13,82	29,60	63,49	3,48	2,42	5,90	1,06
-90	-30	-60	117	42,73	11,97	45,30	48,72	3,15	2,97	6,12	0,18
-180	-90	-132	185	24,87	14,59	60,54	32,17	2,33	3,84	6,17	-1,51
-300	-180	-232	185	14,05	14,59	71,35	21,35	1,74	4,65	6,39	-2,91
-450	-300	-372	162	7,41	4,94	87,65	9,88	1,51	6,07	7,58	-4,56
	-450	-585	127	1,57	0,00	98,43	1,57	1,07	8,68	9,75	-7,61

The good correlation between the difference of goals marked by home and by away teams, and the difference of ranking points between these teams, allows the following expression, obtained by linear regression:

$$\text{Difference of goals} = 0,48 + 0,0137 \times (\text{Difference of ranking points})$$

$$\text{with } r^2 = 0,996.$$

The obtained statistics allow to calculate a modified table for the calculation of points to be won or lost by the teams, according to the difference of ranking points (RP) between the opposing teams.

RP home teams – RP away team	Home team wins	Draw	Home team loses
< - 520	+ 60	+ 30	0
≥ - 520 and < - 340	+ 55	+ 25	- 5
≥ - 340 and < - 250	+ 50	+ 20	- 10
≥ - 250 and < - 160	+ 45	+ 15	- 15
≥ - 160 and < - 110	+ 40	+ 10	- 20
≥ - 110 and < - 85	+ 35	+ 5	- 25
≥ - 85 and < - 20	+ 30	0	- 30
≥ - 20 and < + 40	+ 25	- 5	- 35
≥ + 40 and < + 100	+ 20	- 10	- 40
≥ + 100 and < + 170	+ 15	- 15	- 45
≥ + 170 and < + 230	+ 10	- 20	- 50
≥ + 230 and < + 395	+ 5	- 25	- 55
≥ + 395	0	- 30	- 60

Change of points for home team, according to the result of the match and to the difference of ranking points (RP) between home and away team, for K = 60. The away team has a symmetrical change.

This new table will be considered for the purpose of the calculation of the club women team's ranking, in a match by match manner, after the 16 August 2000.

### 3. Competitions with games played at neutral places

Due to the yet small number of matches included in the database, for these conditions, less than 2.000, an accurate statistical analysis is not yet possible. When the number of matches reaches the 2.000, a provisional study will be presented. Until then, the normal ELO table will be employed to calculate the rankings for these kind of matches.