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THE SCORING SYSTEM IN SPORT

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Abstract. *A scoring system based on positive and negative points has certain advantages because it allows for a more complete and more objective evaluation of the competitors and their interrelations because it uses a new kind of information on a tie score which is disassembled into a positive and a negative part on the basis of penalty kicks; these two new results are antipodes and are of a lower rank than victory and defeat. If it is estimated that, after an unsuccessful competition which has brought no winner after a 90-minute game it would be advisable and opportune to introduce penalty kicks into league competitions in order to get a winner of a lower rank than the one who regularly won the match during the 90-minute game, then the scoring system based on positive and negative points - which follows a 2, 1, -1, -2 pattern - may be successfully applied. This proposal might be worth considering.*

1. REVIEW OF EXISTING SCORING SYSTEMS

The analysis of existing scoring systems in some sports such as baseball, hockey, basketball, football, soccer and others, shows a variety of scoring methods, imperfections and illogicalities.

One of the main imperfection is the incorrect and improper scoring when a tie occurs because each competitor is awarded one point, that means both competitors estimated positively. This is inconceivable and inadmissible! The tie is neither positive nor negative but neutral, one can say a barren result, and for this reason must be scoreless. The existing systems, where the tie is a positive result, support a draw and, in this way, tied scores are a psychological boost for competitors. Therefore the tie has inconvenient and undesirable consequences for the competition.

In the most soccer leagues, in order to mitigate the bad effect of the tie as positive score, points awarded for the victory are increased from two to three. Unfortunately, this does not have any significant effect because the support for the tie as a positive result and the bad consequences of such score remain.

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Problems relating to the tie score can be solved successfully and effectively with the tie breaker, as it is known. In some sports such as baseball and basketball there is no tie thanks to overtime and problems associated with tied scores are eliminated. The scores of each competitor in these sports are the quotient of its victories and the sum of both its victories and its defeats. In this way both the victories and the defeats are equally considered in the score. This is shown in the Pct column on scoreboard. The mathematical expression for the Pct column is:

$$Pct = W/(W+L) .$$

In some national basketball leagues, the Pct is multiplied by 100 and such scores represent the percentage of the victories related to the number of games.

The mathematical expression for the Pct is hyperbolic function, which means that the change in the Pct is diverse when the number of games increases. This is inconvenient because the significance of victories/defeats decreases on the scoreboard when the number of games increases. For this reason we find another column on the scoreboard, the GB column, which is a linear function of the results (W,L). The mathematical expression for the GB column is:

$$GBn = [(W1-Wn) + (Ln-L1)]/2$$

where W1 and L1 are the number of victories and defeats from the first competitor, Wn and Ln are the number of victories and defeats from the competitor n-th place on the scoreboard. GB scores as well as Pct scores include both victories and defeats. But the scoring system in these sports needs two different kinds of scores and this is its inconvenience.

In some national basketball leagues, there is a different scoring system where two points are awarded for the victory and one for the defeat. Consequently, games are also without a tie.

In some soccer leagues, an attempt was made to solve the problem of the tie in such a way that the winner in a tied game is the competitor with better performed penalties, but the result was the positive tie only. It wasn't estimated as a victory. For this reason in such a scoring system the victory is scored with two points and the positive tie with one point. Unfortunately, both unsuccessfully performed penalties in the tie (the negative tie) and the defeat were scoreless although they are two different results in regard to their importance and that is the defect of this scoring system.

In some sports, two points are awarded for the victory as the positive result and the defeat is scoreless as the negative result. That means the defeat is ignored result, while the tie as neutral and barren result is scored with one point, as already mentioned above. This is an evident illogicality! The question is very simple: how can the winner win 2 points what his defeated rival doesn't lose? It is normal and logical that the winner can win only what his defeated rival loses. Unfortunately, the defeat is ignored as a result, it is scoreless as already mentioned. What is the reason?

Also, how can both competitors in a tie situation earn one point? The tie is a neutral result, and no points are lost. Official scoring system support the tie as positive result which is an undesirable and bad feature of the such scoring system.

2. PROPOSAL OF THE PN SCORES SYSTEM

The PN Scores System is based on the principles of informatics and logic using a set of integral numbers:

$$(...,-n,...,-2,-1,0,1,2,...,n,...) .$$

According to the viewpoint of informatics, the victory and the defeat as the antipode of victory with opposite sign have the same informational weight, while the tie has a neutral informational weight in relation to the competitors. For this reason the PN Scores System proposes naturally that:

- *one positive point (+1) be awarded for the victory as a positive result;*
- *one negative point (-1) be awarded for the defeat as a negative result;*
- *the tie as a neutral result be scoreless.*

This means that the PN Scores System is a scoring system with **P**ositive and **N**egative scores.

In accordance with the principle of logic, the winner earns one point, the one that the defeated rival loses. The competitors in a tied game neither win nor lose points because they are nether winners nor losers.

The scores of each competitor are the difference between its victories and defeats. *The essential mathematical expression for PN scores is:*

$$PN = W - L .$$

If the number of defeats is greater than the number of victories, the scores are negative. For this reason scoreboards are divided into two parts, the upper one showing the competitors with the positive scores and the lower one the competitors with the negative scores. Sometimes competitors with zero scores will appear in the middle of the scoreboards. These have the same number of victories and defeats.

The scoreboards partitioned in such a manner provide new and very useful information for the analysis of competitions.

Obviously, the tie doesn't cause any change to the PN columns on the scoreboards because it is scoreless. This is a very significant feature of the PN Scores System because it doesn't give any support to the tie. That means the tie is an ignored scoring result as mentioned earlier, the tie is estimated as a barren contest.

3. APPLICATION OF THE PN SCORES SYSTEM

The application of the proposed PN Scores System should be represented on the scoreboards of some sports in a new column: the PN column.
The hockey scoreboard of NHL standings on February 24, l996. was:

WESTERN CONFERENCE								
Central Division	GP	W	L	T	GF	GA	Pts	PN
Detroit	58	43	ll	4	220	132	90	32
Chicago	61	32	18	11	208	158	75	14
St.Louis	60	26	24	10	164	174	62	2
Toronto	61	25	26	10	181	183	60	-1
Winnipeg	58	24	30	4	195	207	52	-6
Dallas	59	17	31	11	168	207	45	-14

Pacific Division	GP	W	L	T	GF	GA	Pts	PN
Colorado	60	33	17	10	239	171	76	16
Vancouver	61	24	23	14	221	205	62	1
Calgary	61	23	27	11	178	187	57	-4
Los Angeles	62	18	30	14	199	230	50	-12
Edmonton	59	21	32	6	163	225	48	-11
Anaheim	60	21	34	5	166	198	47	-13
San Hose	60	13	41	6	183	259	32	-28

EASTERN CONFERENCE

Atlantic Division	GP	W	L	T	GF	GA	Pts	PN
Rangers	60	34	15	11	215	167	79	19
Florida	59	35	17	7	205	163	77	18
Philadelphia	59	30	18	11	206	161	71	12
Washington	59	28	24	7	168	160	63	4
Tampa Bay	59	27	24	8	180	191	62	3
New Jersey	59	26	25	8	152	146	60	1
Islanders	58	17	33	8	171	223	42	-16

Northeast Division	GP	W	L	T	GF	GA	Pts	PN
Pittsburgh	59	36	19	4	265	197	76	17
Montreal	60	29	24	7	193	183	65	5
Boston	58	25	25	8	203	206	58	0
Hartford	58	25	27	6	168	183	56	-2
Buffalo	59	24	29	6	174	184	54	-5
Ottawa	59	12	44	3	140	223	27	-32

The order of competitors on the scoreboards for the Central, the Atlantic and the Northeast Divisions is identical in regard to the official and the PN scores. However, on the scoreboard for the Pacific Division, Edmonton has -11 PN points which is more than Los Angeles that has -12 PN points. Nonetheless, officially Edmonton is behind.

New information useful for the analysis of rivalries between Divisions that can be derived from the PN scores of the Divisions' competitors is the DS **D**ivision **S**cores. The mathematical expression for DS is:

$$DS = SP - SN$$

where SP is the **S**um of **P**ositive and SN is the **S**um of **N**egative PN Scores. DS represents the scores of one Division related to those of all the other Divisions and depends on the results of the competitors of the other Divisions only and exclusively.

The SP for the Central Division is: 32+14+2=48 and the SN is: 1+6+14=21. Consequently DS is: 48-21=27. Therefore, the Central Division has +27 points, which means that the competitors of the Central Division have 27 victories more than defeats in relation to all competitors of the other Divisions. The DS for the NHL League is represented on the following scoreboard:

NHL League

DIVISION	SP	SN	DS
Atlantic	57	-16	41
Central	48	-21	27
Northeast	22	-39	-17
Pacific	17	-68	-51

Obviously, the sum of positive DS (68) is equal to the negative DS. The sum of positive DS must always be the same as the sum of the negative DS within one league.
There is also new information useful for the analysis of rivalries between Conferences that can be derived from DS scores on DS scoreboards. It is the CS **C**onference **S**cores. The mathematical expression for CS is:

$$CS = DSP - DSN$$

where DSP is the sum of positive and DSN is the sum of negative DS scores. For the Western Conference the DSP is the DS of the Central Division, which is 27, and the DSN is the DS of the Pacific Division, which is -51. Consequently the CS for the Western Conference is: 27-51=-24. The Conferences scoreboard is as follows:

CONFERENCE	DSP	DSN	CS
Eastern	41	-17	24
Western	27	-51	-24

For the Eastern Conference, the CS mean that its competitors have 24 victories more than defeats in the games against the Western Conference competitors. For the Western Conference the CS mean the opposite.

The Baseball scoreboard of the NBA standings of January 4, l997 was:

EASTERN CONFERENCE

Atlantic Division	W	L	Pct	GB	PN
Miami	24	7	.774	-	17
New York	22	8	.733	1.5	14
Washington	15	15	.500	8.5	0
Orlando	11	17	.393	11.5	-6
New Jersey	8	21	.276	15	-13
Philadelphia	8	21	.276	15	-13
Boston	6	23	.207	17	-17

Central Division	W	L	Pct	GB	PN
Chicago	28	4	.875	-	24
Detroit	23	7	.767	4	16
Cleveland	20	10	.667	7	10
Atlanta	17	11	.607	9	6
Charlotte	17	13	.567	10	4
Milwaukee	15	14	.517	11.5	1
Indiana	14	15	.483	12.5	-1
Toronto	10	20	.333	17	-10

WESTERN CONFERENCE

Mildwest Division	W	L	Pct	GB	PN
Houston	24	7	.774	-	17
Utah	22	8	.733	1.5	14
Minnesota	13	18	.419	11	-5
Dallas	10	18	.357	12.5	-8
San Antonio	9	20	.310	14	-11
Denver	8	23	.259	16	-15
Vancouver	6	25	.194	18	-19

Pacific Division	W	L	Pct	GB	PN
L.A.Lakers	23	9	.719	-	14
Seattle	22	11	.667	1.5	11
Portland	17	15	.531	6	2
Sacramento	13	19	.406	10	-6
Golden State	11	18	.379	10.5	-7
L.A.Clippers	11	19	.367	11	-8
Phoenix	10	21	.323	12.5	-11

Division scoreboard is as follows:

DIVISION	SP	SN	DS
Central	61	-11	50
Pacific	27	-32	-5
Atlantic	31	-49	-18
Midwest	31	-58	-27

Conference scoreboard is as follows:

CONFERENCE	DSP	DSN	CS
Eastern	50	-18	32
Western	0	-32	-32

The order of competitors on scoreboards shown above is identical in regard to the official scores and the PN scores because all three columns (Pct, GB and PN) are based both on the victories and on the losses.

The meaning of Division scoreboard and Conference scoreboard already mentioned.

4. SOME CONSIDERATIONS AND OBSERVATIONS

The order of competitors on scoreboards shown above made in accordance with the most official scoring systems (columns Pts and Pct) and with the proposed PN Scores System (column PN) are identical if the competitors have the same number of games. However, the scoring system in soccer leagues is the exception, it is incompatible with all other scoring systems because it is based on different concept and criterion of the score than the other, it scores the victory with +3 points, the tie as a positive result with +1 point and the defeat is ignored as a result.

The order of competitors on official and on the proposed scoreboards is not yet but could be different if the competitors would have a different number of games as for instance Los Angeles and Edmonton in Pacific Division.

How is it possible that the order of competitors both on official and on the proposed PN scoreboards is identical when the analysis of official scoring systems has shown some imperfections and illogicalities!?

As mentioned above, the PN Scores System based on the principles of informatics and logic, and using positive and negative numbers and zero, that is a set of integral numbers, proposes that the victory be scored with +1 point, the defeat be scored with -1 point and the tie be scoreless (0). The essential mathematical expression for the PN scores is, as it is known:

$$PN = W - L$$

where W are the victories, L are the defeats and the tie (T) are scoreless.

All other scoring systems, except soccer scoring system, can be derived from the essential expression when we introduce one constant, marked whit B, as follows:

$$Pg = (B+1)\cdot W + (B+0)\cdot T + (B-1)\cdot L\ .$$

Pg is the general scores expression for the other scoring systems, except soccer scoring system.

If B=1, then Ps is:

$$Ps = (1+1)\cdot W + (1+0)\cdot T + (1-1)\cdot L = 2\cdot W + T + 0\cdot L$$

and it is the standard official scoring system for many sports: the victory is scored with +2 points, the tie is scored with +1 point and the defeat is scoreless.

All scoring systems derived from the general scoring expression (Pg) by any constant B have the same order of competitors on the scoreboards for the same number of games of all competitors; this is their feature. So, for example, if B=-1, then Pg becomes:

$$Pn = (-1+1)\cdot W + (-1+0)\cdot T + (-1-1)\cdot L = 0\cdot W - T - 2\cdot L.$$

This is one scoring system with the negative scores, the victory would be scoreless, the tie would be with -1 point and the defeat with -2 points. Naturally, this example is one illustration only.

Developed and arranged general scores expression Pg becomes:

$$Pf = B\cdot W + W + B\cdot T + B\cdot L - L = B\cdot(W+T+L) + W - L$$

(W+T+L) is the number of games, marked with G (G=W+T+L); W-L are the PN scores (PN=W-L) for the essential scoring system. Therefore the final expression for Pf is:

$$Pf = B\cdot G + PN.$$

The expression of Pf scores explains why the scoreboards both of the proposed PN Scores System and of majority official scoring systems are identical. The member PN of Pf represents the PN scores, and they absolutely sufficient to make the regular order of the competitors on official scoreboards. Therefore, the member B·G is unnecessary because it doesn't offer any new information. Moreover B·G scores are undesirable because they charge the scores, as clumsy scores, smothering the expressivity of PN scores as the net scores. In fact, the number B·G of Pf is the number of games (G) is known already because it is usually on the first column on the scoreboards.

The scoreboards for baseball and basketball in USA and Canada have two columns: Pcs and GB, as it is known, and both columns have the order of competitors identical as the scoreboards of PN scores. It is normally because the scores of both columns are based on the victories and on the defeats. GB scores can be derived from PN scores as follows:

The mathematical expression for GBn scores of n-th competitor is, as mentioned:

$$GBn = [(W1-Wn) + (Ln-L1)]/2.$$

Developed and arranged this expression becomes:

$$GBn = [(W1-L1) - Wn-Ln)]/2.$$

W1-L1=PN1 is the PN scores of the first competitor and Wn-Ln=PNn is the PN scores of

the n-th competitor on the scoreboard, that means GBn derived from PN1 and PNn is:

$$GBn = (PN1 - Pnn)/2.$$

Obviously, both GB scores and PN scores are linear functions of the results (W,L).

Preliminary considerations attest that the PN System Scores:

- *has the identical order of competitors on the scoreboards as the official scoring systems, mentioned earlier;*
- *doesn't give any support to the tie as a positive result; the tie is an ignored scoring result;*
- *make the scoreboard by essential scores without the clumsy scores (B*G) and because of that PN scores as net scores are very expressive for the analysis of competitions;*
- *offers new useful information about the competitions:*
  - the scoreboards are divided into two parts, the upper one showing the competitors with positive scores and the lower one with negative scores;
  - DS are the Division Scores derived from the PN scores; they represent the scores of one Division related to those of all the other Divisions and offer useful information for the analysis of rivalries between the Divisions;
  - CS are the Conference Scores derived from the DS scores; they represent the scores of one Conference related to other Conference and offer useful information for analysis of rivalries between the Conferences.
- *has the universal application because it can substitute the other scoring systems successfully, except actual soccer scoring system.*

5. PROPOSAL OF THE SOCCER SCORING SYSTEM

As mentioned before, using the tie breaker there was a soccer scoring system with a positive and a negative tie. The tie is a positive result after better performed penalties and a negative result after badly performed penalties. In this way, the tie is not undecided contest but the tie is divided into two contrary results: the positive tie and the negative tie. However, the score was incorrect because both the negative tie and the defeat are equally considered scoreless although they are two different results. As well, the victory and the positive tie are different; they are scored correctly, the victory with +2 points and the positive tie with +1 point. Analogously to the score of the victory and the positive tie, the negative tie needs to be scored with -1 point and the defeat with -2 points because they are antipodes of the positive tie and the victory respectively. *The essential expression of this scoring system is:*

$$PN = 2 \cdot W + Tp - Tn - 2 \cdot L$$

Tp is the positive and Tn is the negative tile.

This system correctly considers and scores all the result of the competition: the victories, the positive and negative ties, and the defeats; the scoreboard is without the clumsy scores but it has the net scores only, and it has two parts, the upper on with the positive and the lower one with the negative scores as the scoreboard of PN scores.

Generally, this Soccer Scoring System has all the good and useful features of the proposed PN Scores System.

SISTEM BODOVANJA U SPORTU

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Sistem pozitivnog i negativnog bodovanja ima izvesne pogodnosti jer pruža potpuniju i objektivniju ocenu o takmičenjima i njihovom međusobnom odnosu jer koristi nove informacije o nerešenom rezultatu koji je izvođenjem jedanaesteraca rastavljen na pozitivan i negativan deo; ova dva nova rezultata su međusobno antipodi i nižeg su ranga od pobede i poraza. Ako se oceni da je, posle neuspelog nadmetanja da se kroz igru od 90 minuta dobije pobednik, uputno i oportuno da se i u ligaška takmičenja uvede izvođenje jedanaesteraca radi dobijanja pobednika ali koji je nižeg ranga od onog koji je pobedu izvojevao kroz igru od 90 minuta, tada se sistem pozitivnog i negativnog bodovanja sa šemom 2,1, -1, -2 može uspešno primeniti za bodovanje takvog sistema takmičenja. Možda bi bilo korisno razmotriti ovaj predlog.