Comparing Swiss Tournament Systems

By Wouter Ludwig
897004

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Faculty of Economics and Business Administration
Tilburg University

Supervisors
Dr. R.L.P. Hendrickx
Dr. J.H. Reijnierse

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ABSTRACT

Several variants of the Swiss systems are compared to each other in order to determine the best suitable Swiss tournament system for het Dutch Open Draughts Championship. Also the concept Stationary Tournament Performance Rating is introduced. Using rating formulas to balance score and opponent strength, a new ranking system is recommended to determine the ranking list for the Dutch Open Draughts Championship.

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INTRODUCTION

The Dutch Open Draughts Championship is a tournament with approximately 120 participants. The Swiss system is the best suitable tournament system for such a large number of participants. In a Swiss system only a small number of rounds is played. Players will play against players with approximately the same strength, but will never meet the same opponent more than once. Also at the end of a Swiss tournament we have a ranking list in which all players are ranked, a so called complete ranking list.

A round of a Swiss system contains two important parts. First a pairing is created, in which ideally players with the same number of points play against each other. Secondly, depending on the results of the games played, a ranking list is determined. Based on the ranking list, a pairing is created again. In this way several rounds are played. The result is that we can rank all participants after a small number of rounds.

There are some variants of the Swiss system being used. The most common variants of the Swiss systems are the Swiss system on Solkoff and the Swiss system on Rating. These systems differ in both pairing system and in ranking system. In general the players with the same number of points that faced the strongest opponents are paired against the players that faced the weakest opponents.

In Swiss on Solkoff the player with the strongest opponents is paired against the player with the weakest opponents. In Swiss on Rating the players with the same number of points are divided into two groups, one group with players with the strongest opponents and one group with players with the weakest opponents. Ideally, the players with the strongest opponents of their group will play against each other.

E.g. consider four players with the same number of points. Player 1 faced the strongest opponents, followed by player 2, and player 4 faced the weakest opponents. In Swiss on Solkoff ideally player 1 plays against player 4 and player 2 plays against player 3. In Swiss on Rating ideally player 1 will play against player 3 and player 2 will play against player 4.

For an exact description of the Swiss pairing systems I refer to the handbook of the FIDE (FIDE 1998) for the pairing rules of Swiss on Rating and to the handbook of the KNDB (KNDB 2005) for the pairing rules of Swiss on Solkoff. The FIDE is the International Chess Federation. The KNDB is the 'Koninklijke Nederlandse Dambond', i.e. the Royal Dutch Draughts Federation. In draughts there is no advantage in having black or white. Therefore, in the pairing rules the color preferences are disregarded.

When determining the ranking list, in both systems the first criterion is the number of points. A higher score means a higher place. Second criterion is based on opponent strength. Stronger opponents mean a higher place. Basically, using Swiss on Solkoff the score of one's opponent indicates his strength. In Swiss on Rating the rating of one's opponents indicates his strength.

For the ranking criteria I refer to Annex 3 of the FMJD (FMJD 2005). The FMJD is 'La Fédération Mondiale du Jeu de Dames', i.e. the World Draughts Federation. An example of the ranking criteria can be found in Appendix 3.

The goal of this thesis is to find the best suitable tournament system for the Open Dutch Draughts Championship. To compare the different Swiss systems in a quantitative and scientific way, we need to quantify the performance of these Swiss systems.

When we consider a round robin tournament, i.e. a tournament in which all players have played against each other at the end of the tournament, we can compare all players fairly at the end of the tournament. For a large number of participants a round robin tournament would be very time-consuming. We consider the performance of players with the same number of points in a round robin tournament equally strong. If the individual results between all couples of the participants are known, we can set up a ranking list, in which players with the same score tie.

Regardless the order in which the players have played against each other, at the end of a round robin tournament the ranking list will always be the same. Consider a Swiss system as an unfinished round robin tournament and consider the ranking list of the Swiss system as a prognosis of the ranking list at the end of the round robin tournament. Based on the quality of the prognoses of the different Swiss systems, the Swiss systems will be compared.

In Chapter One the concept of the Stationary Tournament Performance rating is introduced. Also we introduce two new Swiss systems that combine the pairings of the existing Swiss systems with the Stationary Tournament Performance Rating as ranking method. To show how we can compare the performance of the different Swiss systems, based on round tournaments, we use data from the World Championship of Draughts in 2007.

To compare the different Swiss tournament systems we need tournaments that are based on the same data. This data will be obtained by simulation. In Chapter Two we prepare the simulation of many Swiss tournaments. For the simulation we need information about the distribution of the player strength and we need results of individual games. We explain the techniques that are used to create input for the simulations.

In Chapter Three we find the results of the simulation of many Swiss tournaments. The results will be explained and based on the results of the simulation some tests are performed to find the best tournament system for the Open Dutch Draughts Tournament.

In Chapter Four examples of drawbacks of the current Swiss systems are given. These inconveniences can be solved by using the STPR ranking system. This thesis concludes with recommendations to implement the best variant of the Swiss tournament system for a Dutch Open Championship.

CHAPTER ONE

Comparing tournament systems based on WC 2007

Introduction

In 2007 the KNDB organized the World Championship in Hardenberg. In this championship 20 players from all over the world, who made it successfully through the preliminary rounds, joined together in a round robin competition to decide who would become the new World Champion.

Over the last decades the ultimate championship has always been played in a round robin competition, since the round robin system is considered to be the most suitable system to determine a fair and complete ranking list for a small number of players.

At the end of the tournament, the participants are ranked on the number of points. In the World Championship of 2007 Schwarzman and Podolskij scored the most points. We could consider the performance of both players equally strong. However, to make the tournament more attractive, and to increase the chance of having a single winner at the end of the championship, some tie-breaking criteria were constructed.

E.g. the tie-breaking criterion that the player with the most victories is ranked higher is constructed in order to make the tournament more attractive, not to distinguish strength of the players. The tie-breaking criteria are usually in favor of the attractive players, not necessarily in favor of the strongest players. Schwarzman won and lost one more game than Podolskij, and therefore became the new World Champion.

We assume that the performance of the players can be purely based on the number of points that the players scored during the round robin tournament. A higher number of points is translated into a better performance. When some players score the same number of points in this round robin tournament, we do not make a distinction in the performance of the players.

It took 19 rounds to play the World Championship of 2007. Suppose that the whole tournament should have been played within two weeks and that players would have refused to play more than one round per day. A round robin competition would not have been possible anymore. We could have played a Swiss championship of five, six or seven rounds and with the best eight players we could have played a round robin final championship. To determine the best eight out of the twenty participants we need to use a Swiss system.

We compare the following Swiss Systems.

- Swiss on Solkoff, with pairing on Buchholz
- Swiss on Buchholz, with pairing on Buchholz
- Swiss on Rating, with pairing on Rating
- Swiss on Stationary Tournament Performance Rating, with pairing on Buchholz
- Swiss on Stationary Tournament Performance Rating, with pairing on Rating

First we only compare the ranking system of the Swiss system. An example of the ranking system of the Swiss system on Solkoff, on Buchholz and on Rating can be found in Appendix 3. The ranking system of

STPR will be introduced later on.

Buchholz is the Chess-term for sum of opponents scores. This is equivalent to the Dutch draughts term 'Weerstandspunten'. To distinguish the system in which the sum of opponent scores is used as secondary ranking criterion from the system in which the sum of opponent scores minus the highest and the lowest opponent score, we use the terms Buchholz and Solkoff respectively. The pairing system of Swiss on Buchholz and Swiss on Solkoff are the same. Pairing on Buchholz is equivalent to pairing on Solkoff. The latter two systems, in short Swiss on STPR, are based on my Bachelor Thesis. (Ludwig 2007).

To illustrate the comparison of performance of the Swiss tournament systems, we use the results of the World Championship of 2007. We define the best tournament system for x rounds as the system that provides a complete ranking list after x rounds with the smallest deviation from the final ranking list when all players played against each other. The differences are quantified with the following formula.

$$\sum_i \left| P_i^{\mathrm{roundx}} - P_i^{\mathrm{final}} \right| \qquad (1$$

Here, i denotes a player and $\boldsymbol{P_i}$ denotes his position. When players tie, we use an average for $\boldsymbol{P_i}$.

Example Differences (120 participants)

Assuming that there are 49 players that win their first round, all these players share the places 1 up to 49. The average place is 25. If the strongest player in the tournament won his game his difference in position would be 24 places. If two weak players play against each other in the first round and one of them wins the difference in location is even larger. E.g. the number 86 of the final ranking list is paired in the first round against the number 114 of the final ranking list. Assuming the number 86 is one of the 49 players who won his game, his difference is 86-25=61.

Summing up the differences in position over all participants gives a score. The lower this score, the better the prognosis that is given by the ranking list.

First we introduce the tournament systems and illustrate the comparison of the performance of the ranking system, by using the pairing system of the Round Robin tournament. We determine the ranking list after five rounds of the World Championship of 2007 based on the criteria of the Swiss Tournament Systems. The results of the games of the first five rounds of the World Championship are used.

In table 1.1 we find the results and the pairings of the first round of the World Championship of 2007.

Round 1

White	Black	Result
2	5	1-1
17	20	0-2
12	15	1_{+}-1_{-}
18	19	1-1
13	14	0-2
8	9	2-0
1	6	1-1
3	4	1-1
7	10	2-0
11	16	1-1

Table 1.1 (Tournament Base 2007)

Lottery Number	Player
1	Lagoda, Yuriy
2	Amrillaew, Mourodoullo
3	Anikeev, Yuriy
4	Georgiev, Alexander
5	Domchev, Aleksej
6	Misans, Roberts
7	Schwarzman, Alexander
8	Chizhov, Alexey
9	Valneris, Guntis
10	Tuvshinbold, Otgonbayaryd
11	Ndjofang, Jean Marc
12	Podolskij, Mark
13	Scholma, Auke
14	Van den Akker, Jeroen
15	Ba, Souleymane
16	Samb, Ndiaga
17	Pierre, Ricardo
18	Kouogueu, Kouomou Leopold
19	Thijssen, Kees
20	Mikhalchenka, Ihar

Table 1.2

Table 1.2 shows the lottery numbers with the corresponding participants in the tournament. The names are spelled in the same way as in the world rating list (FMJD 2008).

E.g. in round 1, Amrillaew (2) played a draw against Domchev (5), Pierre (17) lost against Mikhalchenka (20), Podolskij (12) played an advantageous draw against Ba (15), and so on. In this tournament an advantageous draw was scored when having a significantly better, but not winning endgame.

The results and the pairings of round 2 up to and including round 19 (Tournament Base 2007) can be found in Appendix 1. The final standings can be found in table 1.3

Pl	Name	Rating	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Pt	W	+	-
1	Schwarzman	2410	x	1	1	0	1	2	1	2	1	1+	1	2	1	1+	1	1	2	2	2	2	25	7	2	0
2	Podolskij	2438	1	x	1	1	2	1	1+	2	1	1	1	1	1	1	1+	2	1	2	2	2	25	6	2	0
3	Georgiev	2438	1	1	x	2	1+	1	1	1	2	2	1	1+	1-	1	1	1	1	1	2	2	24	5	2	1
4	Chizhov	2449	2	1	0	x	1	1	1	1+	1	2	1	1	2	1	1+	1	1	2	1+	2	23	5	3	0
5	Scholma	2329	1	0	1-	1	x	1	1	1	2	1	2	0	1	1	1	2	2	0	2	2	22	6	0	1
6	Anikeev	2328	0	1	1	1	1	x	1	1	1	2	1	1	1	2	1	1	2	1+	2	1	22	4	1	0
7	Amrillaew	2305	1	1-	1	1	1	1	x	1	1	1	1	1+	1	1	1	1	1-	1	2	2	21	2	1	2
8	Kouogueu	2355	0	0	1	1-	1	1	1	x	2	1	1	2	1	1	1	0	1	2	1	2	20	4	0	1
9	Ndjofang	2364	1	1	0	1	0	1	1	0	x	1	2	1	0	1	1+	2	2	2	1	1	19	4	1	0
10	Samb	2341	1-	1	0	0	1	0	1	1	1	x	1	2	2	1	1	2	1	0	1	2	19	4	0	1
11	Mikhalchenka	2344	1	1	1	1	0	1	1	1	0	1	x	1-	1	1	2	1	0	2	2	1+	19	3	1	1
12	Vd Akker	2324	0	1	1-	1	2	1	1-	0	1	0	1+	x	1-	1	2	1	1	1	2	1+	19	3	2	3
13	Valneris	2386	1	1	1+	0	1	1	1	1	2	0	1	1+	x	1	1+	1	1	1-	2	1+	19	2	4	1
14	Misans	2341	1-	1	1	1	1	0	1	1	1	1	1	1	1	x	1	1	1+	1	1+	2	19	1	2	1
15	Ba	2271	1	1-	1	1-	1	1	1	1	1-	1	0	0	1-	1	x	1	1	2	0	2	18	2	0	4
16	Domchev	2316	1	0	1	1	0	1	1	2	0	0	1	1	1	1	1	x	1	1-	1+	2	17	2	1	1
17	Thijssen	2362	0	1	1	1	0	0	1+	1	0	1	2	1	1	1-	1	1	x	1-	0	2	16	2	1	2
18	Lagoda	2301	0	0	1	0	2	1-	1	0	0	2	0	1	1+	1	0	1+	1+	x	1	2	15	3	3	1
19	Pierre	2203	0	0	0	1-	0	0	0	1	1	1	0	0	0	1-	2	1-	2	1	x	2	13	3	0	3
20	Tuvshinbold	2175	0	0	0	0	0	1	0	0	1	0	1-	1-	1-	0	0	0	0	0	0	x	5	0	0	3

Table 1.3 (Tournament Base 2007)

The Swiss tournament systems are hardly compatible with plusses and minuses. Ranking primarily on number of points, secondarily on plusses and minuses, and finally on opponent strength would make the opponent strength more or less irrelevant. Ranking primarily on number of points, secondarily on opponent strength and finally on plusses and minuses would make advantageous draws more or less irrelevant. Since the tournament is used as an example for large tournaments and to illustrate how we compare the different Swiss tournament systems we change the advantageous draws into the usual draws. In the round robin tournament we use the ranking criteria of the tournament, in which advantageous draws are possible.

After five rounds of playing a round robin competition, we determine the ranking lists of the round robin ranking systems, the Solkoff ranking system, the Buchholz ranking system, the rating ranking system in Appendix 3. Also a brief explanation of the ranking system of each system is added. The ranking list of the Stationary Tournament Performance Ranking system is given in table 1.5. First we introduce the ranking method of the Stationary Tournament Performance Rating.

Ranking system of Stationary Tournament Performance Rating

First of all we define the concept Tournament Performance Rating, in short TPR. The TPR of a player is defined as the rating for which the expected score according to the Elo rating system (Elo 1978) is equal to actual score.

In chess the scoring system is 0 points for a loss, half a point for a draw and one point for a victory. In draughts the scores are doubled.

In Swiss on Stationary Tournament Performance Rating all players are given a rating that matches their Tournament Performance Rating. The player with the best performance is ranked highest. The number of points scored is only indirectly important.

According to the Elo rating system (Elo 1978) the expected score of player i against player j in chess is given by equation 2.

$$E(R_i, R_j) = \Phi(\frac{R_i - R_j}{200\sqrt{2}}) \qquad (2$$

In which R_i is the rating of player i. R_j is the rating of player j and Φ is the cumulative distribution function of the standard normal distribution.

Hence, the expected score in draughts is given by equation 3.

$$E(R_i, R_j) = 2 * \Phi\left(\frac{R_i - R_j}{200\sqrt{2}}\right) \qquad (3$$

The expected score of player i in a tournament can be given by equation 4.

$$ES_i = \sum_{j \in O_i} E(R_i, R_j) \qquad (4$$

In which ES_i is the expected score of player i, and O_i is the set of opponents of player i. Consequently, if the TPR of player i is equal to R_i, it holds that $\sum_{j \in O_i} E(R_i, R_j) - S_i = 0$ in which S_i is the score of player i.

For the following example we define TPR_i^* as the TPR when a draw is added to the initial rating. Thus the solution of $\sum_{j \in O_i} E(TPR_i^*, R_j) - S_i + E(TPR_i^*, R_i) - 1 = 0$.

Example STPR

Consider the following small tournament:

	Rating	Player 1	Player 2	Player 3	Player 4	Points	TPR	TPR*	STPR
Player 1	2500	X	1	2	.	3	2616.5	2573.2	2605.7
Player 2	2450	1	X	.	2	3	2622.6	2557.7	2554.6
Player 3	2400	0	.	X	2	2	2425.0	2416.1	2384.8
Player 4	2350	.	0	0	X	0	$-\infty$	2123.4	2142.5

Table 1.4

To compute the expected scores we use equation 2. A player with a rating of 2616.5 has an expected score of 1.44 against a player with 2450 and an expected score of 1.56 against a player with rating 2400. Together the score is 3 points. Therefore the TPR according to our definition of TPR is 2616.5. The TPR of player 4 would be, using the normal distribution function, $-\infty$, since he scored zero points.

In search for a stationary tournament performance rating, this $-\infty$ would cause mathematical problems. Computing the TPR of player 3 when the rating of player 4 would be equal to $-\infty$ would also become $-\infty$. Therefore TPR* is defined. Including an artificial a draw against the individual rating would make sure that infinite ratings do not occur.

A draw against the individual ratings has a consequence on the fairness of the system. If two players play against exactly the same opponents, and score exactly the same number of points, the player with the highest initial rating will end up higher. Another possibility would be to give all participants a fictitious draw against the average rating of all participants. In this case the place on the final ranking list of a participant does not depend on the initial rating of the participants.

Nevertheless, adding a draw against the initial rating of a participant makes the system less sensitive to a particular result. E.g. suppose that a grandmaster would lose a game on time against a somewhat weaker player. The TPR* of the somewhat weaker player would be very high. If a draw would be added against his individual rating, his TPR* would still be high, but his TPR* would be demptioned. The result is that for a small number of rounds played the TPR* gives a more reasonable image of the strength of this participant.

The TPR* of player 1 is 2573.2. With this rating the expected scores are 1.46 against 2400, 1.34 against 2450 and 1.20 against 2500. The sum of the expected scores is 4 points, which equals the scores against all opponents accumulated by the 1 point for the fictitious draw.

Since the TPR* deviates from his initial rating, we could assume that the player in this tournament is actually stronger than his rating tells us. Consequently, his opponents suffer from the low rating this player had in the tournament.

We define the STPR as the solution for the set of equations given by

$$\sum_{j \in O_i} E(STPR_i, STPR_j) - S_i + E(STPR_i, R_i) - 1 = 0 \; \forall i \in \{1, \cdots, n\}. \qquad (5$$

Hence, all players have exactly the tournament performance that is given by their STPR.

For the proof of the existence of a unique STPR I refer to Appendix 2.

Running scores after five rounds ranked by STPR

Pl	Name	Rating	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	St. PR	Pt
1	Chizhov	2449	X	.	.	1	1	.	.	.	.	.	.	2	.	.	.	2	.	.	.	2	2527,8	8
2	Podolskij	2438	.	X	1	.	.	.	.	.	.	.	.	.	.	.	1	.	2	2	1	.	2452,1	7
3	Vd Akker	2324	.	1	X	.	.	.	.	.	.	.	1	.	.	.	1	.	2	.	2	.	2445,0	7
4	Misans	2341	1	.	.	X	.	.	.	.	1	.	.	1	.	.	.	1	.	.	.	2	2387,2	6
5	Anikeev	2328	1	.	.	.	X	1	.	1	1	1	.	.	.	.	.	.	.	.	.	.	2384,4	5
6	Mikhalchenka	2344	.	.	.	.	1	X	.	1	1	1	.	.	.	.	.	.	.	.	.	2	2374,7	6
7	Domchev	2316	.	.	.	.	.	.	X	.	.	.	0	.	1	1	.	.	.	2	2	.	2367,9	6
8	Georgiev	2438	.	.	.	.	1	1	.	X	1	1	.	.	.	.	.	1	.	.	.	.	2365,9	5
9	Lagoda	2301	.	.	.	1	1	1	.	1	X	1	.	.	.	.	.	.	.	.	.	.	2361,2	5
10	Thijssen	2362	.	.	.	.	1	1	.	1	1	X	.	1	.	.	.	.	.	.	.	.	2355,2	5
11	Amrillaew	2305	.	.	1	.	.	.	2	.	.	.	X	.	1	1	.	.	.	0	.	.	2350,1	5
12	Schwarzman	2410	0	.	.	1	.	.	.	.	.	1	.	X	.	.	.	1	.	.	.	2	2341,1	5
13	Kouogueu	2355	.	.	.	.	.	.	1	.	.	.	1	.	X	1	.	.	1	1	.	.	2325,9	5
14	Samb	2341	.	.	.	.	.	.	1	.	.	.	1	.	1	X	1	.	.	1	.	.	2324,6	5
15	Ndjofang	2364	.	1	1	.	.	.	.	.	.	.	.	.	.	1	X	.	0	.	1	.	2286,6	4
16	Scholma	2329	0	.	.	1	.	.	.	1	.	.	.	1	.	.	.	X	.	.	.	1	2282,8	4
17	Valneris	2386	.	0	0	.	.	.	.	.	.	.	.	.	1	.	2	.	X	.	1	.	2281,7	4
18	Pierre	2203	.	0	.	.	.	.	0	.	.	.	2	.	1	1	.	.	.	X	.	.	2276,0	4
19	Ba	2271	.	1	0	.	.	.	0	.	.	.	.	.	.	.	1	.	1	.	X	.	2224,2	3
20	Tuvshinbold	2175	0	.	.	0	.	0	.	.	.	.	.	0	.	.	.	1	.	.	.	X	2055,2	1

Table 1.5 Stationary Tournament Performance Rating

When we take a look at the expected score matrix given in table 1.6 we find the expected results from all players playing against each other. In table 1.7 only the expected scores from the games played are given. Adding up the values from each row result in the number of points scored accumulated by the point they scored against their initial rating.

Considering that a strong performance should be translated in a high ranking means that we do not necessarily rank primarily on the number of points scored by the player. E.g. after five rounds the performance of Anikeev is better than the performance of Domchev, while Anikeev scored one point less.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	***1,22***	1,21	1,23	**1,38**	**1,39**	1,41	1,43	1,43	1,44	1,46	1,47	**1,49**	1,52	1,53	1,61	**1,61**	1,62	1,63	1,72	**1,91**
2	0,79	*1,04*	1,02	1,18	1,19	1,22	1,23	1,24	1,25	1,27	1,28	1,31	1,34	1,35	1,44	1,45	1,45	1,47	1,58	1,84
3	0,77	0,98	*1,33*	1,16	1,17	1,20	1,22	1,22	1,23	1,25	1,26	1,29	1,33	1,33	1,42	1,43	1,44	1,45	1,56	1,83
4	0,62	0,82	0,84	*1,13*	1,01	1,04	1,05	1,06	1,07	1,09	1,10	1,13	1,17	1,18	1,28	1,29	1,29	1,31	1,44	1,76
5	**0,61**	0,81	0,83	0,99	*1,16*	**1,03**	1,05	**1,05**	**1,07**	**1,08**	1,10	1,12	1,16	1,17	1,27	1,28	1,28	1,30	1,43	1,76
6	0,59	0,78	0,80	0,96	0,97	*1,16*	1,02	1,02	1,04	1,06	1,07	1,09	1,14	1,14	1,24	1,25	1,26	1,27	1,41	1,74
7	0,57	0,77	0,78	0,95	0,95	0,98	*1,07*	1,01	1,02	1,04	1,05	1,08	1,12	1,12	1,23	1,24	1,24	1,25	1,39	1,73
8	0,57	0,76	0,78	0,94	0,95	0,98	0,99	*0,80*	1,01	1,03	1,04	1,07	1,11	1,12	1,22	1,23	1,23	1,25	1,38	1,73
9	0,56	0,75	0,77	0,93	0,93	0,96	0,98	0,99	*1,17*	1,02	1,03	1,06	1,10	1,10	1,21	1,22	1,22	1,24	1,37	1,72
10	0,54	0,73	0,75	0,91	0,92	0,94	0,96	0,97	0,98	*1,14*	1,01	1,04	1,08	1,09	1,19	1,20	1,21	1,22	1,36	1,71
11	0,53	0,72	0,74	0,90	0,90	0,93	0,95	0,96	0,97	0,99	*0,97*	1,03	1,07	1,07	1,18	1,19	1,19	1,21	1,34	1,70
12	0,51	0,69	0,71	0,87	0,88	0,91	0,92	0,93	0,94	0,96	0,97	*0,81*	1,04	1,05	1,15	1,16	1,17	1,18	1,32	1,69
13	0,48	0,66	0,67	0,83	0,84	0,86	0,88	0,89	0,90	0,92	0,93	0,96	*0,92*	1,00	1,11	1,12	1,12	1,14	1,28	1,66
14	0,47	0,65	0,67	0,82	0,83	0,86	0,88	0,88	0,90	0,91	0,93	0,95	1,00	*0,95*	1,11	1,12	1,12	1,14	1,28	1,66
15	0,39	0,56	0,58	0,72	0,73	0,76	0,77	0,78	0,79	0,81	0,82	0,85	0,89	0,89	*0,78*	1,01	1,01	1,03	1,17	1,59
16	0,39	0,55	0,57	0,71	0,72	0,75	0,76	0,77	0,78	0,80	0,81	0,84	0,88	0,88	0,99	*0,72*	1,00	1,02	1,16	1,58
17	0,38	0,55	0,56	0,71	0,72	0,74	0,76	0,77	0,78	0,79	0,81	0,83	0,88	0,88	0,99	1,00	*0,87*	1,02	1,16	1,58
18	0,37	0,53	0,55	0,69	0,70	0,73	0,75	0,75	0,76	0,78	0,79	0,82	0,86	0,86	0,97	0,98	0,98	*1,20*	1,15	1,56
19	0,28	0,42	0,44	0,56	0,57	0,59	0,61	0,62	0,63	0,64	0,66	0,68	0,72	0,72	0,83	0,84	0,84	0,85	*0,87*	1,45
20	0,09	0,16	0,17	0,24	0,24	0,26	0,27	0,27	0,28	0,29	0,30	0,31	0,34	0,34	0,41	0,42	0,42	0,44	0,55	*0,67*

Table 1.6

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	***1,22***			**1,38**	**1,39**							**1,49**				**1,61**				**1,91**
2		*1,04*	1,02												1,44		1,45	1,47	1,58	
3		0,98	*1,33*								1,26				1,42		1,44		1,56	
4	0,62			*1,13*					1,07			1,13				1,29				1,76
5	**0,61**				*1,16*	**1,03**		**1,05**	**1,07**	**1,08**										
6					0,97	*1,16*		1,02	1,04	1,06										1,74
7							*1,07*				1,05		1,12	1,12				1,25	1,39	
8					0,95	0,98		*0,80*	1,01	1,03						1,23				
9				0,93	0,93	0,96		0,99	*1,17*	1,02										
10					0,92	0,94		0,97	0,98	*1,14*		1,04								
11			0,74				0,95				*0,97*		1,07	1,07				1,21		
12	0,51			0,87						0,96		*0,81*				1,16				1,69
13							0,88				0,93		*0,92*	1,00			1,12	1,14		
14							0,88				0,93		1,00	*0,95*	1,11			1,14		
15		0,56	0,58											0,89	*0,78*		1,01		1,17	
16	0,39			0,71				0,77				0,84				*0,72*				1,58
17		0,55	0,56										0,88		0,99		*0,87*		1,16	
18		0,53					0,75				0,79		0,86	0,86				*1,20*		
19		0,42	0,44				0,61								0,83		0,84		*0,87*	
20	0,09			0,24		0,26						0,31				0,42				*0,67*

Table 1.7

Comparing Swiss Tournament Systems

After each round we can make a ranking list for each system, as shown in table 1.8. Obviously, every round the expected ranking lists looks more like the final ranking list and the expected ranking lists of the several tournament systems are more alike. The complete table can be found in Appendix 4.

With these results we can calculate the differences between the places of the ranking list after x rounds and the place of the final ranking list, so we can determine the best tournament system. The smaller the differences are, the better the tournament system gives a prognosis of the final ranking list. For each round we determine the differences.

Name	System	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6	Round 7	Round 8	Round 9	Round 10
Lagoda	RR	6-15	6-13	13-15	12-14	10	11	6	11	15	16
	SOLKOFF	5-16	8-16	10-13	13	9	8-9	9	11-12	14-15	16
	B/SB	5-16	8-13	9-11	10-12	9	8-9	10	15	16	16
	RATING	10-11	12	12	8	9	8	9	11	14	16
	STPR	14	12	10	12	9	9	10	12	15	16

Table 1.8 -1

Name	System	Round 11	Round 12	Round 13	Round 14	Round 15	Round 16	Round 17	Round 18	Round 19	Final*
Lagoda	RR	18	19	19	19	18	18	19	18	18	18
	SOLKOFF	17	18	19	19	18	18	19	18	18	
	B/SB	18	19	19	19	18	18	19	18	18	
	RATING	17	18	19	19	18	18	18	18	18	
	STPR	19	19	19	19	18	18	18	18	18	

Table 1.8-2

Example Differences Lagoda

Lagoda, the player with the highest lottery number, had a good start and was ranked 10th after five rounds of the round robin competition. In the other systems he is ranked 9th. At the end of the tournament he would end 18th. We find only small differences between each system, which is reasonable since the ranking lists of each system are based on the results of the same five rounds.

In round 1 Lagoda shares place 6 up to and including 15 with 9 other players. We give all ten players the average place 10.5. 18-10.5=7.5, so the difference for Lagoda, in the round robin tournament, from his final ranking is 7.5 places.

We compute the differences for all players for each round and for each tournament system. The result of the average differences is shown figure 1.1.

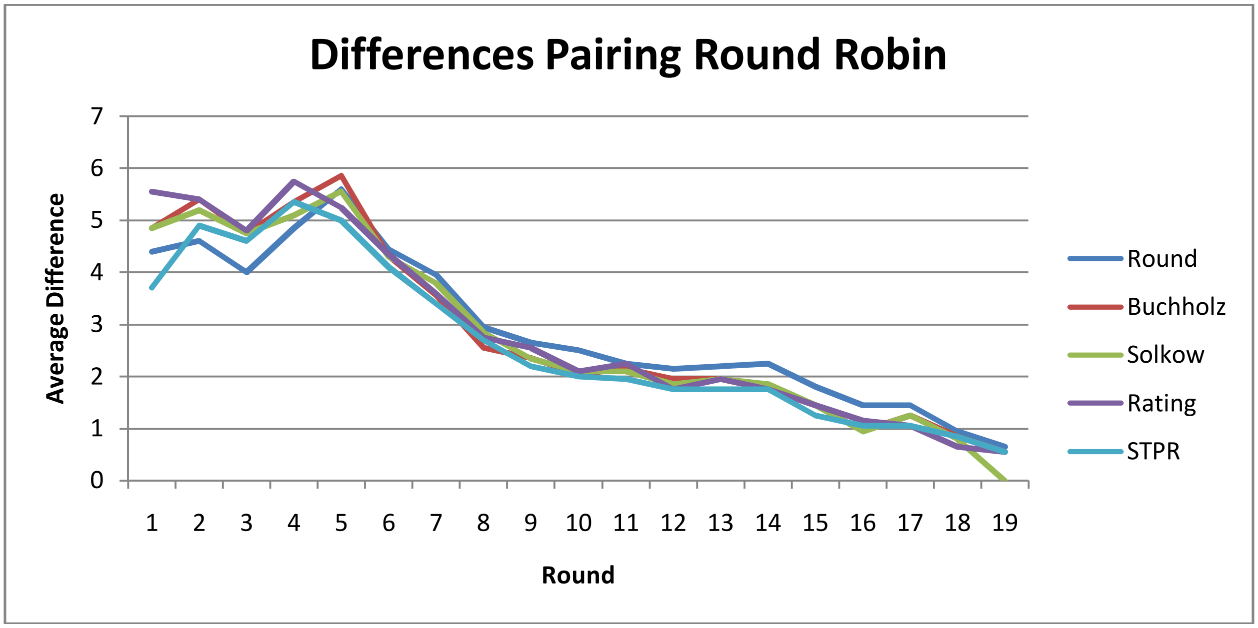


Figure 1.1

We find that between five and seven rounds Swiss on STPR performs best, or gives the best prognosis of the final ranking list. We need to keep in mind that this is only based on one tournament and more important, it is based on the results of a round robin pairing. Thus only the ranking part of the Swiss system is involved. The pairing system is also an important part of a Swiss tournament system.

It should not be possible to win all games without playing against any opponent with many points. Using the Swiss tie-breaking criteria without using the Swiss pairing system is not a proper way of judging a Swiss Tournament System. Nevertheless the previous figures show that the Swiss System on STPR shows a lot of potential, since it provides the best ranking lists based on the same results on what the other systems base their ranking lists.

The next step is to determine the pairings according to the corresponding Swiss tournament systems. Since the Swiss pairing systems are different, the results of different pairings are used for the ranking lists. When we compare the performance of the Swiss systems, we need to keep in mind that the performance of the systems can be caused by the ranking method, but also by the different pairings. If a strong player loses against a weak player, this is bad for the performance of the system. Since the pairings are different, a part of the performance is due to some of these outliers in the scores.

The pairing system that is used for Buchholz and Solkoff is based on the KNDB Handbook (KNDB 2005). The pairing system that is used for Rating is based on the FIDE Handbook (FIDE 2008). The color preferences are disregarded. For the STPR system paired like Buchholz we used the same pairing system as for Buchholz and Solkoff, in which the Buchholz score is changed into the STPR score. For the STPR system paired on rating, we use the same pairing as of the system of Swiss on Rating.

We find the running scores after five rounds and the Swiss pairings in Appendix 5.

When we complete the whole tournament we find the ranking lists of Lagoda in table 1.9. The complete table can be found in Appendix 6.

Name	System	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6	Round 7	Round 8	Round 9	Round 10
Lagoda	RR	6-15	6-13	13-15	12-14	10	11	6	11	15	16
	SOLKOFF	17-20	14-20	19-20	18	19	17	18	18	19	19
	B/SB	17-20	15-20	20	18	18-19	18	18	18	19	19
	RATING	9	16	10	9	11	10	5	9	9	10
	STPR	19	17	16	17	17	18	19	18	17	16
	STPR R	15	16	14	14	13	12	10	11	11	12

Table 1.9-1

Name	System	Round 11	Round 12	Round 13	Round 14	Round 15	Round 16	Round 17	Round 18	Round 19	Final*
Lagoda	RR	18	19	19	19	18	18	19	18	18	18
	SOLKOFF	19	19	18	18	18	18	17-18	17-18	18	
	B/SB	19	19	18	18	18	18	18	18	18	
	RATING	12	16	16	17	17	17	17			
	STPR	15	16	15	16	16	15	18	18	18	
	STPR R	13	16	16	16	17	18	18			

Table 1.9-2

We find some larger differences between the systems, since the rankings are based on different scores. In the same way as mentioned earlier the differences are computed for each player, for each round and for each system. With these values we can calculate the differences again and we find the results of the average differences in figure 1.2

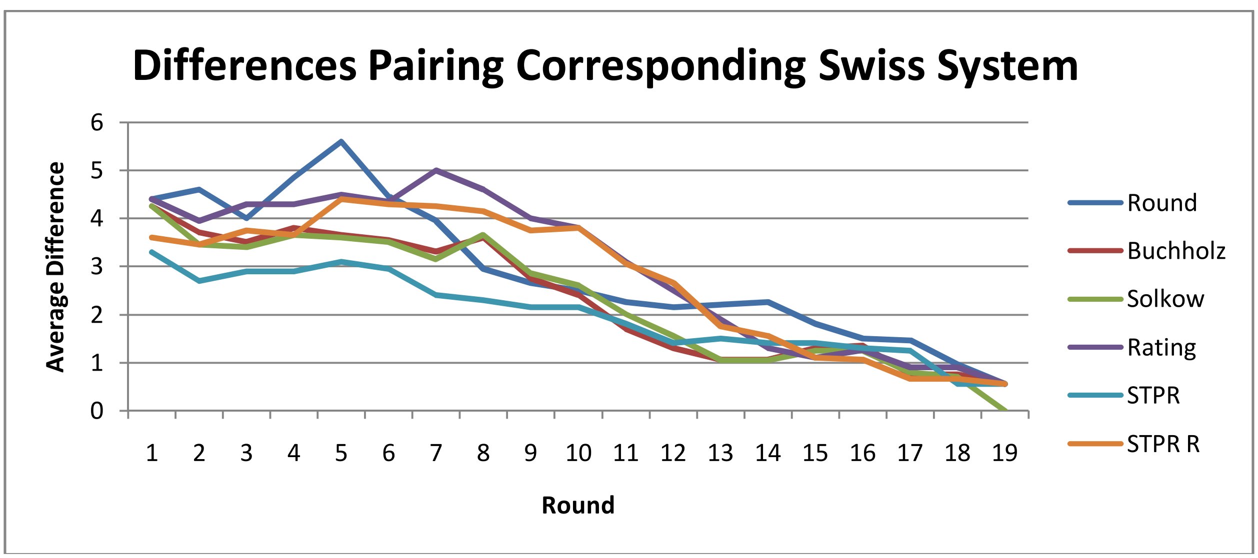


Figure 1.2

After 17 rounds of pairing Swiss on rating, there are three players that only have to play against each other. Consequently, it is not possible to provide a ranking for round 18. One of the three players would not have an opponent. Therefore we cannot make up a ranking list after 18 rounds for the systems with pairing on ratings. The ranking list of round 18 is copied from round 17. The scores of round 19 have been copied from the round robin pairing system, since after 19 rounds all players have played against each other in all tournament systems.

Again we find that the Swiss system on STPR performs better than the other systems on rounds 5 until 7. We also find that the Swiss on Rating scores poorly. The STPR with the Rating Pairing system is already better, although the STPR with the 'Buchholz' Pairing is far better. Since the ranking method is the same in both cases, we can conclude that in this case either the pairing system of the Rating system is poor, either the games selected by the pairing procedure came up with some score outliers with respect to the final ranking list. Scores like Scholma-Lagoda (0-2) or Domchev-Kouougue (2-0) are outliers from Scholma and Kouougue that have great impact on the ranking list when a small number of rounds is played.

To determine the best tournament system we need to simulate many tournaments to find out which system gives the best ranking lists on the long run, such that the conclusion is not based on some outliers. Also, the Swiss System is mainly used for large tournaments, with many participants and large deviation in the strength of the participants. This also means amongst others that the population of the tournament could be different and the deviation in the scores of all games could be different.

CHAPTER TWO

Population and results in a Swiss tournament

Introduction

Based on one tournament we cannot make any conclusions. The main goal of this thesis is to find the best Swiss system for large tournaments. To provide strong statements about the performance of the different Swiss tournament systems we need many Swiss Tournaments. There is no data of large round tournaments available. Therefore we use simulation techniques to simulate many tournaments in order to be able to compare the different Swiss systems.

To simulate these tournaments in a realistic way it is necessary to know something about the strength of the players that participate in a large tournament. Also we need individual results between players. Based on the results of players with the same strength as the participants in the tournament we can simulate tournaments like the Dutch Open Championship.

Considering the distribution of the strength of the participants in a tournament, we need to keep in mind some specifics of the Dutch Open Championship. in the Dutch Open Championship prizes are not only awarded for the best players in the tournament, but also for players that performed best in their categories. There are some rating categories, and there are categories for women, disabled, young players, seniors, etc.

The Dutch Open Championship is a great experience for young players. They can face strong opponents, learn to play with a serious time limit and develop their skills in a short amount of time. Also they can take a look at their idols since even some grandmasters are invited to create a prestigious tournament and give participants the opportunity to play against the best players of the world.

Therefore, we find a large deviation in strength of the players. This large deviation in strength is different than from any other competition. When simulating a tournament, the ratings of the participants in the simulation should match the ratings of the players in the past Open Dutch Championships.

Apart from simulating participants with the strength of the population of a tournament, we also need to simulate reasonable individual results between the players that have to play against each other.

We need individual results between all couples of the participants of a simulated Swiss tournament. With all the individual results between the couples we can determine the ranking list of a round robin tournament. By simulating different Swiss tournaments, we can compare the performance of different Swiss systems, based on the results of the same round robin tournament.

Population of a Swiss tournament

The ratings of the participants of the last five years of the Open Dutch Championship are used to estimate the distribution of strength of the participants. Some descriptive statistics of the ratings of the participants of these tournaments can be found in table 2.1.The descriptive statistics of the ratings of the participants of each of the Open Dutch championships can be found in Appendix 7.

Tournament Statistics	2004-2008 Together
Total Number of participants	626
Without Rating	71
With Rating	555
Maximum Rating	482
Maximum	1588
Mean	1124
Median	1128
Standard Deviation	217

Table 2.1 (Tournament Base 2008)

The statistics show participants with ratings between 482 and 1588. Also, over 10% of the participants do not have a rating. More information about the distribution of the participants with rating can be found in figure 2.1.

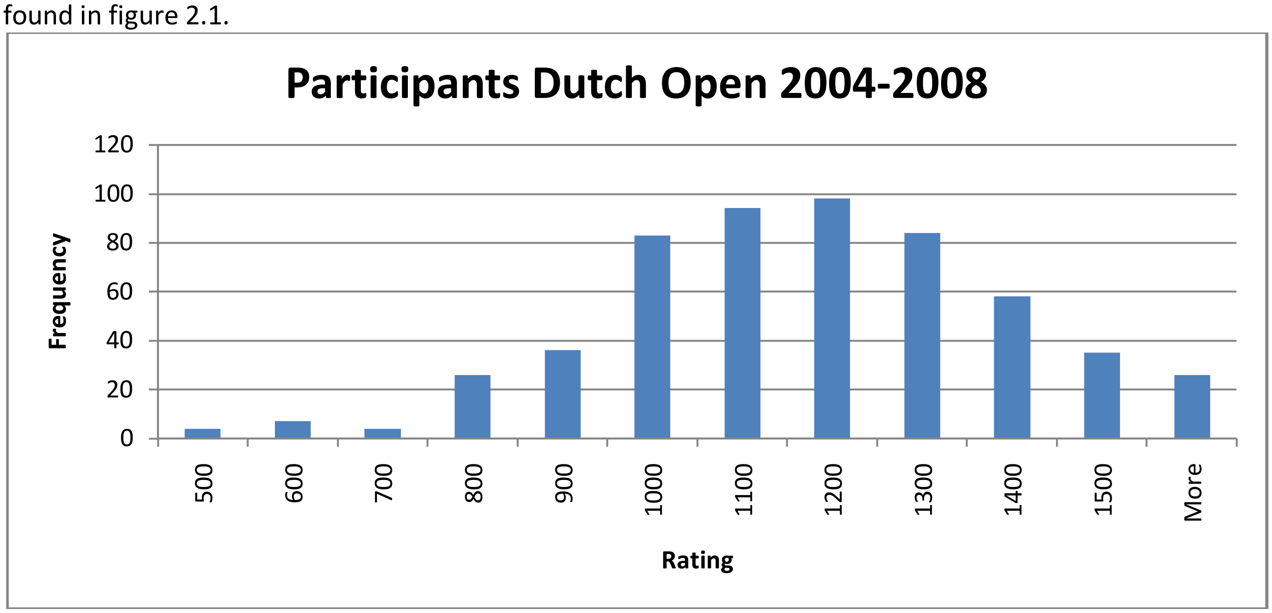


Figure 2.1 (Tournament Base 2008)

It would be convenient to know the distribution of the participants. For the simulation we could simply draw from the distribution that matches the strength of the participants. A reasonable first assumption worth testing would be that the participants in the Open Dutch Championships are normally distributed.

We test for normality with a Jarque-Bera test (Jarque and Bera 1981). A Jarque-Bera test gives a test-statistic based on kurtosis and skewness. Kurtosis is a measure for the shape of the tails. Thick tails means a high kurtosis, thin tails mean a low kurtosis. Skewness is a measure for symmetry. Negative skewness means that the left tail is longer. Positive skewness means that the right tail is longer. If the skewness is close to zero, we have symmetry.

Given the number of observations, the skewness and the kurtosis, a test-statistic is derived. The Jarque-Bera test-statistic increases with respect to thickness of the tails, and with respect to asymmetry. Consequently, for a high test-statistic we have thick tails or a lack of symmetry. Since the perfectly symmetric normal distribution has thin tails we have to reject the normality assumption for a high test statistic.

The ratings of the players of the Open Dutch Championships over the last five years shows coefficients for Skewness and Kurtosis of -0.23 and 2.99 respectively, which gives a high Jarque-Bera statistic of 4.83. The assumption of normality can be accepted for p=0.08, which is very small. We have to reject the assumption that the distribution of the participants is normal.

We cannot draw from the normal distribution. A different technique is to use players from the past directly for our simulations. The ratings of players from the past five years give a reasonable indication of the distribution of the strength of the players. To simulate the participants we use participants over the last five years. We put all ratings of the participants together in a pool of 628 ratings and draw 120 ratings for each Open Dutch championship to be simulated. The result is that the distribution of the ratings in our simulation matches the ratings of the participants over the last five years.

Results in a Swiss tournament

Of most participants we have some information about their previous results, namely their rating. Their rating gives an approximation of their strength. With the ratings we can compute the expected scores. From the the individual results of all played games in the last five open Dutch Championships a histogram can be found in figure 2.2.

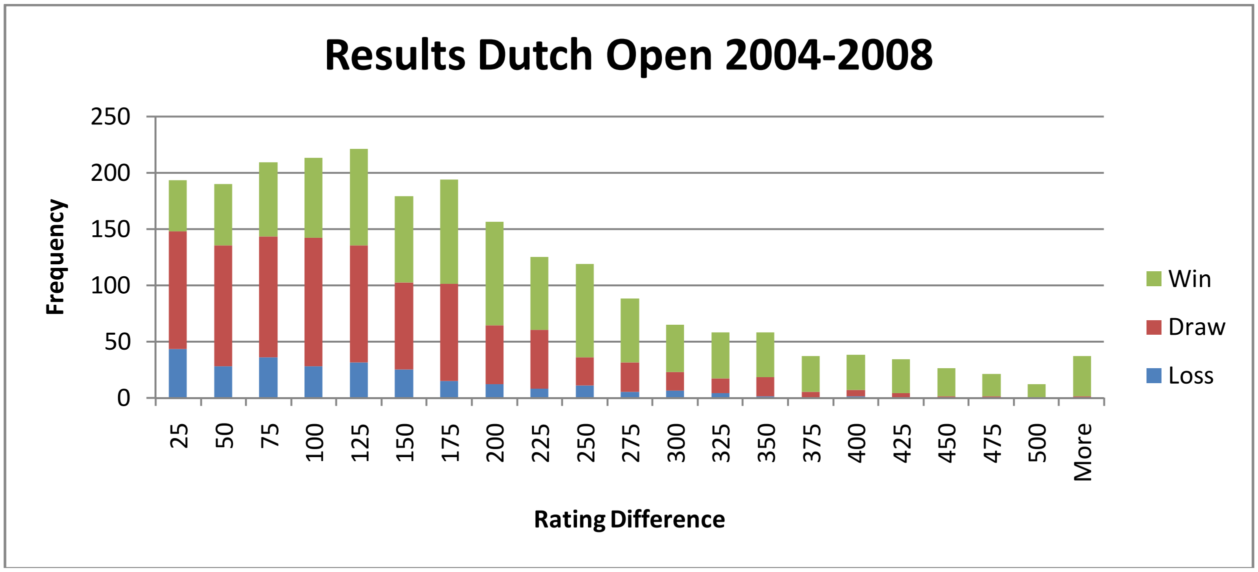
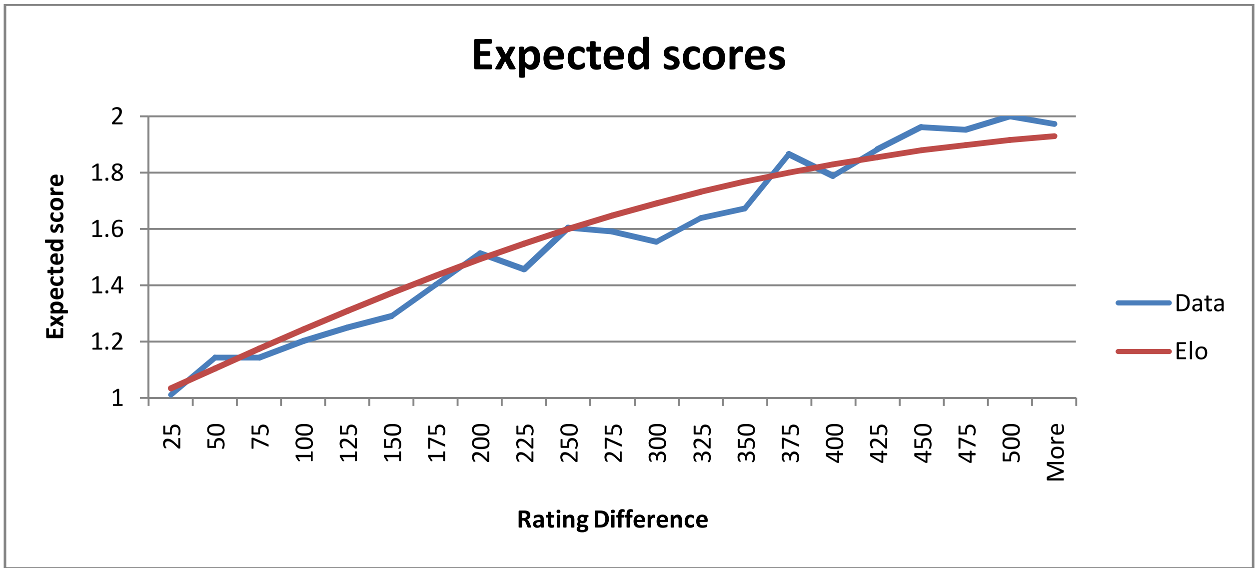


Figure 2.2

From these results we can compute the expected scores using equation 2. We compare the expected scores to the expected scores that are given by the Elo rating formula (Elo 1978) in figure 2.3. We find that the results in the Dutch Open Championships match the expected results. Since the rating function is generally accepted, we can conclude that the results of the Dutch Open Championships are not different from any other results, which seems reasonable.

However, in order to simulate results the expected scores are not enough. The expected score does not tell us anything about the chances of winning and losing. The expected chances of winning and losing could be derived from the data of the Dutch Open Championships like in figure 2.2. However, it is not unreasonable that the chances of losing and winning do not only depend on the rating difference, but are also dependent on the level of the players. E.g. two grandmasters with a rating difference of 25 points will probably play more draws than two beginners with the same rating difference.



Figuur 2.3

To simulate the individual results between the participants of the tournament we use results from the past. First all players are given a rating. For the approximately 10% without a rating, a rating is guessed. In practice it is not very difficult to estimate the rating of an unknown player. For example, for young players, their trainer can estimate their ratings. Based on the performance of the players without a rating during the Open Dutch championships a rating, rounded at 50 points, is guessed. The players with guessed ratings are given a rating at random that differs maximum 50 points from their guessed rating in order to estimate the results of these players.

For each couple of two players we have the ratings of both players. In a large dataset of results by players with ratings we search for results between players, not necessarily the same players, with the same ratings. If there are multiple results in the dataset, randomly one of the results is chosen. If no result occurs in our dataset, we search in the neighborhood of the ratings of the two players. In that case, we allow the ratings to differ one rating point, and we repeat the search. If again no results occur, we increase the allowed difference with an extra rating point, until a result is found in our dataset.

In order to obtain some deviation in the scores it is desirable to use a large dataset. In a small dataset the result between a player with rating 1500 against a player with rating 800 might also be used for 1450-750 and every rating couple in between, if there a no other rating couples in the neighbourhood of 1500-800 with previous results.

The dataset of the last five Dutch Open Championships is rather small, and since we concluded that the results from the games played in the Dutch Open Championships are not different from any other results we can use a different dataset. A somewhat larger dataset with over 18000 results from 2002-2004 is used to simulate the results between all players.

Example Simulating Results (fictitious)

We have two players with rating 1100 and 980 respectively. In our dataset we cannot find any games played with these two exact ratings. Therefore we allow the ratings to differ one point from the original ratings. In our dataset we find two wins and a draw between two players with 1101 and 980 and we find a loss and a draw for a player with rating 1100 against 979. Randomly one of these results is chosen.

CHAPTER THREE
Results and conclusions

Introduction

In Chapter Two we created a pool of approximately 626 ratings of participants from the past five Open Dutch Championships. Drawing 120 ratings from this pool gives us the ratings for one tournament to be simulated. For each couple of ratings we search for an individual result for the round robin tournament. We use the method as described in the Example of Simulating Results in the end of Chapter Two. The round robin tournament results end the ratings of the participants, if necessary estimated, are used as input for the simulation of a Swiss tournament.

All tested Swiss systems consist out of two phases, namely giving a pairing and determining a ranking list. The results of the games given by a pairing are obtained directly from the round robin tournament results.

The pairings are given by a Matlab program that obeys the pairing rules of the different Swiss systems. For the pairing rules of the Swiss on Rating I refer to the FIDE handbook (FIDE 1998). The colors have not been taken into account, since in draughts the colors are not important. For the pairing rules of the Swiss on Buchholz I refer to the handbook of the KNDB (KNDB 2005). After each round a ranking list is determined and the pairing of the next round is given, until ten rounds are played.

For each Swiss system and for each round we compute the average differences of all players, using formula 1, like in the Differences Lagoda Example of Chapter One. With these average differences we can compare the different Swiss tournament systems.

Results

For each tournament we find the average difference for each round. The averages over all 100 tournaments are given in table 3.1 and figure 3.1

	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6	Round 7	Round 8	Round 9	Round 10
Buchholz	26.32	22.39	19.15	16.92	15.16	13.85	12.92	12.17	11.67	11.05
Solkoff	26.32	23.08	19.46	17.09	15.25	13.88	12.94	12.17	11.67	11.05
Rating	13.74	16.20	14.99	13.58	12.72	11.95	11.51	11.10	10.72	10.24
STPR	11.94	12.78	13.18	12.87	12.29	11.69	11.20	10.60	10.15	9.80
STPR R	10.81	11.57	12.00	11.64	11.21	10.67	10.28	9.88	9.51	9.15

Table 3.1

Since the pairing of the first round of the Buchholz and Solkoff system is at random and moreover, players with the same score share their places, we find a large average difference in position when comparing the ranking lists after round one and the final ranking list.

When using the pairing system of the Rating system, the players with the highest rating play against the players with the lowest ratings. If all players with the highest rating would win, these players will all be ranked in the best half, and the player with the highest rating leading the ranking list. Since many of the stronger players will win their first round, the ranking list after one round is already a decent prognosis of the final ranking list. This explains the differences of performance from the first round. Nevertheless, the ranking lists of round 7-10 are more important, and the results of the prognoses of the first few rounds are more or less irrelevant.

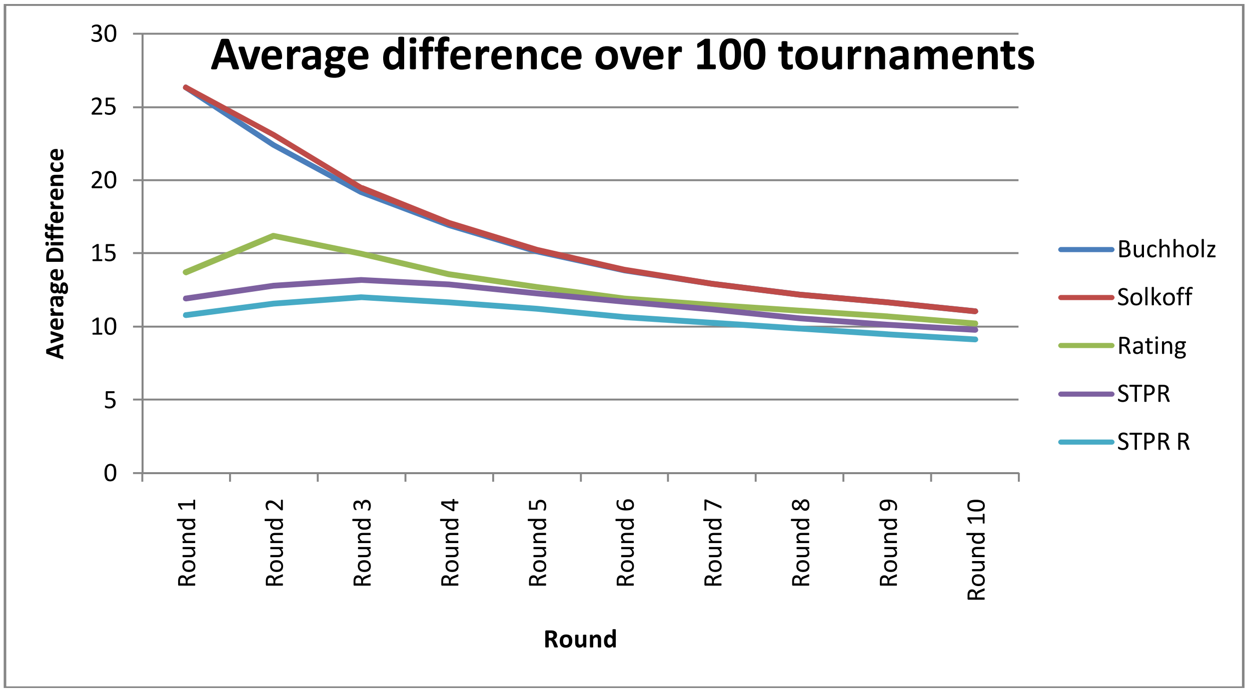


Figure 3.1

In the second round the rating differences between the players are smaller and therefore it is reasonable to assume that we find more draws. Since for the average opponent rating draws are in favor of the players who play against opponents with high ratings, in the second round we find that the ranking list is a little worse than the first ranking list. This effect is smaller for the STPR R since a fictitious draw against the individual rating is added. After each rounds the counter effect of the fictitious draw becomes smaller. After four rounds we find that the differences go down for all systems when an extra round is played.

Conclusions

With the results we perform a Wilcoxon Signed Ranks Test (Bain and Engelhardt 1991) to find out whether we can conclude that one of the systems is significantly better than another one after 9 rounds, since this is the most commonly used number of rounds for a tournament with 120 participants. We compare two Swiss systems at a time. In a Wilcoxon Signed Ranked Test we compare paired data. For each of the 100 simulated round tournaments we find the performances of the prognosis of the two tested Swiss systems. For each tournament we have a paired observation.

The differences of the two performances are computed and given a sign. If the performance of the first system is better than the performance of the second system, the difference is given a positive sign, otherwise the difference is given a negative sign. Next, the differences are ranked. A high difference means a high rank.

We accumulate the ranks of the positive signs, thus the observations in which the performances of the first tested system are better than the second tested system, and we also accumulate ranks of the negative signed differences.

Depending on which sum is higher, we test that the first system is better than the second system, or that the second system is better than the first system. Depending on the number of observations and the sum of the ranks, a test statistic is computed. Basically, if the sum of the ranks is high enough, we can distinguish the two systems on their performance.

We perform the test on the average differences after round 9 of all 100 tournaments. First we test Buchholz versus Solkoff.

Figure 3.2 shows the result of the Wilcoxon Signed Ranks Test. We find that out of the 100 tournaments 54 times the Swiss on Solkoff performs better, and that in 43 tournaments the Swiss on Buchholz system performs better. In the 43 cases that the Buchholz performs better, the difference with the Solkoff system is larger than the difference of the 54 cases in which the Solkoff performs better. The test statistics show that we can accept the hypothesis that Solkoff performs better than Buchholz at p=0.063, which is very small. We cannot distinguish the two systems based on their performance.

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Solkoff - Buchholz	Negative Ranks	54[a]	44,82	2420,50
	Positive Ranks	43[b]	54,24	2332,50
	Ties	3[c]		
	Total	100		

a. Solkoff < Buchholz

b. Solkoff > Buchholz

c. Solkoff = Buchholz

Test Statistics[b]

	Solkoff - Buchholz
Z	-,158[a]
Asymp. Sig. (2-tailed)	,874

a. Based on positive ranks.

b. Wilcoxon Signed Ranks Test

Figure 3.2

Next, we compare Swiss on Solkoff with Swiss on Rating. We can accept the hypothesis that Swiss on Rating performs better than Swiss on Solkoff at p=0.999, which is very large. We can conclude that Swiss on Rating performs better than Solkoff. The Wilcoxon Signed Ranks Test can be found in Appendix 8.

When comparing Swiss on Rating to Swiss on STPR, both paired on rating, we can conclude at p=0.999 that the STPR ranking system is better than the Swiss on Rating ranking system. Finally we compare STPR paired on Buchholz to STPR paired on Rating. The corresponding Wilcoxon Signed Ranks Tests can be found in Appendix 8. We can conclude at p=0.999 that STPR paired on rating is better than STPR paired on Buchholz. Obviously, STPR paired on Rating performs best amongst the tested systems.

CHAPTER FOUR
Discussion and Recommendations

Introduction

In this chapter we take a look at some examples in which the inconveniences of the current Swiss tournament systems are shown. Most examples are based on the latest Dutch Open Championship, The Hague Open 2008. Based on these examples some improvements are recommended.

All these improvements finally result in the Swiss system on STPR. In Chapter Three we have shown that the Swiss system on STPR performs best amongst the tested Swiss systems. In this chapter there is also some room for discussion. The goal of this thesis was to find the tournament system that provides the best ranking list and to test the competing different Swiss tournament systems.

Some of the improvements in performance are at the expense of other aspects that are desirable in a ranking system. E.g. the transparency, the fairness or the sensitivity of a result. It is clear that the transparency of the ranking system pays for the improvements in performance.

This thesis concludes with some steps of recommendations in order to improve the performance of the Swiss systems. Based on the priority of the different aspects that are desirable in a ranking system, the tournament organization can think of implementing only a part of these steps.

Discussion

We have shown that the performances of the STPR systems are better than the current Swiss systems. By giving several examples we show why the ranking systems of the current Swiss systems give worse performances than the Swiss systems on STPR.

Example Tradeoff between Points and Opponents Strength

We consider the Dutch Open of 2008 in The Hague. We compare Bronstring with Provoost. Bronstring scored 12 points out of 9 rounds. Provoost scored 11 points out of 9 rounds. Therefore Bronstring is ranked higher according to the Swiss system. The strength of the opponents is irrelevant for the ranking list since there is a difference in score.

The opponents of the players are given in table 4.1

Bronstring	Provoost
Van Amerongen (1027)	Baksoellah (1033)
Van den Hoorn (859)	Van Os (1172)
Kreder (1134)	Valneris (1543)
Veerman (1125)	Koopmanschap (1259)
Van Schaik sr. (1098)	Schwarzman (1557)
Amrillaew (1493*)	Burgerhout (1313)
Leemberg (1116)	Clasquin (1215)
Soumah (1321)	Thijssen (1512)
Jacobsen (1092)	Getmanski (1539)

*Estimated from FMJD-rating

Table 4.1 (Tournament Base 2008)

The average opponent rating according to the final ranking differs over 200 points! In every ranking list of a Swiss tournament we find some of these extreme cases. This also holds for tournaments with Swiss on Solkoff. Clearly, there should be a tradeoff between the number of points scored and the strength of the opponents. The tradeoff of the Elo rating function used by the KNDB and the FMJD is generally accepted for rating calculations.

The rating to score 12 points against the opponents of Bronstring is 1277.4. With expected scores of 1.62, 1.86, 1.39, 1.41, 0.45, 1.47, 1.43, 0.88 and 1.49 that sum up to 12. The rating to score 11 points against the opponents of Provoost is 1448.6. With expected scores of 1.86, 1.67, 0.74, 1.50, 0.70, 1.37, 1.59, 0.82 and 0.75 that sum up to 11. Obviously the performance of Provoost was better than the performance of Bronstring. Nevertheless, Bronstring is ranked higher.

Example Average Opponent Rating

Consider two players with a rating of 1500, both hoping to win the championship. Player 1 faced a young player with rating 600. Also he played against a GMI with rating 1550. His average opponent rating over these two players is 1075. Player 1 played a draw against the GMI and won against this weaker player.

His competitor, Player 2, faced two mediocre players with ratings of 1100. His average opponent rating is higher than the average opponent rating of Player 1. Also he scored 3 points and is ranked higher than Player 1. The score of player 1 is excellent. He played a draw against a stronger player and won his other game. The score of player 2 is actually not that good. Although he also won one game, the rating function tells us that he would have an expected score of 3.84 points! This is in contradiction to the AOR-criterion.

Since the rating function is not linear, the average opponent rating is a poor criterion to define opponent strength. The given example is somewhat extreme and theoretical. Due to the pairing system very weak players are hardly ever put in the position to be paired against strong players. However, the problem arises all the time in some smaller extent.

E.g. consider two players with rating 1200. Player 1 played against two opponents both with ratings of 1050. Player 2 faced two opponents with ratings 900 en 1200. Both players scored 3 points.

Player 1 had two weaker opponents. Using equation 3 we find that a score of 2.71 would be expected against the players of 1000 and 1200, while a score of 2.81 points would be expected against the players of 1100. The differences are not negligible.

Example Buchholz

Player 1 faced two opponents who both 7 points. The average rating of players with 7 points is about 900. Player 2 faced two players with 4 and 10 points. The average rating of a player who scored 4 points is about 500 and the average opponent rating of a player who scored 10 points is about 1400. Just like the example of Average Opponent Ratings, the Buchholz is not linear.

The advantage of using Solkoff is that a strong player who faced a very week opponent is still able to compete on Buchholz with other players of his score group. On the other hand, differences between players are eliminated, which makes it more difficult to provide a decent ranking list.

Example False Buchholz

Bronstring and Thijssen both scored 12 points in the Dutch Open of 2008. If Buchholz would be used, playing against Thijssen would be awarded with the same Buchholz-score as playing against Bronstring. Playing against Bronstring would even be awarded more than playing against Provoost of the Example Tradeoff between points and opponent strength.

Example False Rating

The same example can be found for ratings. Take for example a talented young player like Van IJzendoorn. His rating is 982, but in fact he is already stronger. His average opponent rating is 1165.6 and he scored 8 points. The opponents of Van IJzendoorn are put at disadvantage. There are weaker players than Van IJzendoorn with the same rating as Van IJzendoorn. Also players that are in great shape, are focused on the tournament, or just feel good, but also players that have personal problems, use plenty of alcohol during the tournament or are exhausted can deviate from their original strength.

Example Byes

Dummy players, (multiple) telephone calls and players not showing up are all reasons to assign two points to the opponent without playing. These results all have impact on the ranking list. Assigning no result to the game in question would also cause problems in the current Swiss systems since we cannot compare a player with the score 10 out of 9 with a player who scored 9 out of 8. The AOR of Buchholz would become irrelevant when the average score of all players would be assigned.

Considering all these examples we find that there are some inconveniences in the current Swiss system. Some of these inconveniences can be easily solved. Other require some drastic action. The Swiss on STPR would solve all given inconveniences. However, there are also some consequences of the STPR system. Some consequences can be explained as an advantage, but also as a drawback.

First of all, it is difficult to understand how the scores are determined. It is also difficult for humans to check whether the results given by the computer are correct. This is a drawback of the system.

Secondly, the results of your opponents influence your performance, which can be explained as an advantage and a drawback. At the last round of the tournament it becomes more difficult, or practically impossible, for players to calculate their place on the ranking list, depending on other scores. Participants will probably see this as a drawback, but it can also be explained as an advantage.

Finally, some players with the same strength according to the FMJD-Ratings can deviate in STPR considerably. The results that cause the difference between the players can also be the result of luck. A player could win a game on time in a losing position. In this case it is beneficial to be an opponent of the lucky player.

Another positive consequence of the system is that the system can handle different kind of scoring systems. The system coops with the scoring system {0-2, 1-1, 2-0}, but any score system that can be expressed in percentages ({0%-100%, 50%-50%, 100%-0%}). E.g. the system does not coop with {0-3, 1-1, 3-0}, but it does coop with {0-2, ½-1½, 1-1, 1½-½, 2-0}. Also it is possible to eliminate scores and still compute the STPR. E.g. Playing against Dummy gives the same result as not playing a game at all, since it does not influence ones STPR.

Recommendations

As mentioned earlier, some drawbacks of the ranking system of Swiss on Rating can be solved easily. The following steps are given in such an order, that first step 1 should be realized, before step 2 can be realized and so on. Also every step is an improvement that does not require the following step to be realized.

To make sure that participants understand the system, it is wise to implement only the first two steps immediately. Those steps have hardly any negative consequences. When some tournaments are played after step 2 is realized, it will be only a matter of time before it becomes clear to participants that using TPR as a primary ranking criterion gives a better ranking list. Then, the revolutionary step 3 can be realized. This is an important step that should be implemented, but to reduce complaints caused by unfamiliarity and ignorance, it does not have the highest priority. To handle participants with false or unknown ratings, the Swiss can be improved by using Swiss on STPR.

Step 1

Use Swiss on Rating and not Swiss on Solkoff.

Step 2

Do not use the Average Opponent Rating criterion. Instead, compute the rating that matches the results (TPR). In the TPR a draw against the individual rating is not included.

Step 3

Use TPR as primary ranking criterion. TPR is more important than the number of points scored.

Step 4

Do not take into account results with byes (playing against dummy equals winning against a player with rating of minus infinity). The TPR is computed over the games that are played. Also when a player does not show up, the game should not be taken into account.

Step 5

In the final ranking list, change the estimated initial rating of players to their TPR.

Step 6

Use STPR for the final ranking list.

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APPENDICES

Appendix 1

Results WC 2007 per round

Round 2

White	Black	Result
5	3	1-1
20	18	1-1
19	14	1-1
11	12	1-1
15	13	1-1
6	7	$1_{-}-1_{+}$
10	8	0-2
9	4	$1_{+}-1_{-}$
1	2	1-1
16	17	1-1

Table A1.1

Round 3

White	Black	Result
3	1	$1_{+}-1_{-}$
18	16	1-1
17	12	0-2
14	15	2-0
13	11	2-0
9	10	$1_{+}-1_{-}$
8	6	1-1
7	2	1-1
4	5	1-1
19	20	2-0

Table A1.2

Round 4

White	Black	Result
1	4	1-1
16	19	1-1
20	15	2-0
12	13	2-0
11	14	1-1
7	8	0-2
6	9	1-1
10	5	0-2
2	3	1-1
17	18	1-1

Table A1.3

Round 5

White	Black	Result
4	2	1-1
19	17	0-2
18	13	1-1
15	11	$1_{-}-1_{+}$
14	12	1-1
10	6	0-2
9	7	1-1
8	3	1-1
5	1	$1_{-}-1_{+}$
20	16	1-1

Table A1.4

Round 6

White	Black	Result
1	9	$1_{+}-1_{-}$
14	17	2-0
13	16	1-1
12	20	1-1
11	19	2-0
5	8	1-1
4	7	1-1
3	6	2-0
2	10	2-0
15	18	1-1

Table A1.5

Round 7

White	Black	Result
10	1	0-2
18	14	2-0
17	13	0-2
16	12	1-1
20	11	0-2
9	5	1-1
8	4	0-2
7	3	2-0
6	2	1-1
19	15	1-1

Table A1.6

Round 8

White	Black	Result
1	7	0-2
14	20	$1_{+}-1_{-}$
13	19	2-0
12	18	2-0
11	17	1-1
5	6	1-1
4	10	2-0
3	9	1-1
2	8	1-1
15	16	1-1

Table A1.7

Round 9

White	Black	Result
8	1	2-0
16	14	2-0
20	13	0-2
19	12	1-1
18	11	2-0
7	5	1-1
6	4	1-1
10	3	1-1
9	2	1-1
17	15	2-0

Table A1.8

Round 10

White	Black	Result
1	11	0-2
9	19	1-1
8	18	$1_{+}-1_{-}$
7	17	2-0
6	16	1-1
5	15	1-1
4	14	$1_{+}-1_{-}$
3	13	1-1
2	12	$1_{-}-1_{+}$
10	20	$1_{-}-1_{+}$

Table A1.9

Round 11

White	Black	Result
12	1	2-0
20	9	1-1
19	8	1-1
18	7	0-2
17	6	1_{-}-1_{+}
16	5	2-0
15	4	1-1
14	3	1-1
13	2	1-1
11	10	1-1

Table A1.10

Round 12

White	Black	Result
1	15	0-2
9	13	1-1
8	12	1-1
7	11	1-1
6	20	1-1
5	19	1-1
4	18	1-1
3	17	2-0
2	16	1-1
10	14	1_{-}-1_{+}

Table A1.11

Round 13

White	Black	Result
20	1	2-0
18	9	1-1
17	8	1_{-}-1_{+}
16	7	1_{-}-1_{+}
15	6	1-1
14	5	1-1
13	4	1_{-}-1_{+}
12	3	1-1
11	2	1-1
19	10	2-0

Table A1.12

Round 14

White	Black	Result
1	17	1-1
9	15	1_{+}-1_{-}
8	14	1-1
7	13	1-1
6	12	1-1
5	11	0-2
4	20	1-1
3	19	2-0
2	18	1-1
10	16	0-2

Table A1.13

Round 15

White	Black	Result
16	1	0-2
14	9	1_{-}-1_{+}
13	8	1-1
12	7	1-1
11	6	1-1
20	5	1-1
19	4	1-1
18	3	1-1
17	2	0-2
15	10	2-0

Table A1.14

Round 16

White	Black	Result
1	19	1_{+}-1_{-}
9	17	2-0
8	16	2-0
7	15	1-1
6	14	1-1
5	13	0-2
4	12	1-1
3	11	1-1
2	20	1-1
10	18	0-2

Table A1.15

Round 17

White	Black	Result
18	1	2-0
16	9	2-0
15	8	1_{-}-1_{+}
14	7	0-2
13	6	1-1
12	5	2-0
11	4	0-2
20	3	1-1
19	2	1_{+}-1_{-}
17	10	2-0

Table A1.16

Round 18

White	Black	Result
1	13	2-0
9	11	2-0
8	20	1-1
7	19	2-0
6	18	1-1
5	17	1_{+}-1_{-}
4	16	2-0
3	15	1-1
2	14	1_{+}-1_{-}
10	12	0-2

Table A1.17

Round 19

White	Black	Result
14	1	1-1
12	9	1-1
11	8	1-1
20	7	1-1
19	6	1_{-}-1_{+}
18	5	0-2
17	4	0-2
16	3	0-2
15	2	1-1
13	10	2-0

Table A1.18

Appendix 2

Existence STPR

Proof existence of an unique STPR

Theorem:

There exists a solution x to the system of equations
$f_i(\boldsymbol{x}) = \sum_{j\in O_i} E(x_i, x_j) - s_i + E(x_i, r_i) - 1 = 0 \; \forall \; i \in N$
in which

O_i = The set of opponents of player i
x_i = Stationairy Performance of player i
r_i = Finite rating of player i
s_i = Total score of player i
n = Number of participants
N = The set op participants $\{1,2,\cdots n\}$
$E(a,b) = 2\phi(\frac{a-b}{200\sqrt{2}})$
$\phi(z) = \int_{-\infty}^{z} \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}t^2}$ dt (Standard normal cumulative distribution function)

We use the following method to prove that the system of equations has a solution. First we create a compact collection of ratings in which we could find a solution if there is a solution. Then we define a continuous objective function that is zero if and only if x solves the system of equations, and is greater than zero if x does not solve the system. Finally we show that if x does not solve the system of equations, then we can find a different x within the compact domain for which the objective function gives a lower value. Consequently, if there exists a minimum, the minimum should be equal to zero. According to Weierstrass (Kaper and Norde 1996) a continuous function on a compact domain has a minimum. Since the minimum has to be zero, there exists a solution to the system of equations.

First we show that the collection in which we could find a solution, if there is a solution, is compact.

Without the loss of generality we can state that $x_1 \geq x_2 \geq \cdots \geq x_n$.
Define $S(a,b)$ as the score of player a against player b. Notice that $\sum_{j\in O_i} S(i,j) = s_i$. Define g as the number of rounds in a tournament. Define M_i as the solution of
$gE(M_i, M_{i+1}) - 2g + E(M_i, \max(\boldsymbol{r})) - 1 = 0 \;\; \forall i \in \{1,2,\cdots,n-1\}$ and define $M_n = \max(\boldsymbol{r})$. Notice that $M_i > M_{i+1} \; \forall i \in \{1,2,\cdots,n-1\}$ Also define $L_1 = \max(\boldsymbol{r})$ and define L_i as the solution of
$gE(L_i, L_{i-1}) + E(L_i, \max(\boldsymbol{r})) - 1 = 0 \;\; \forall i \in \{2,3,\cdots,n\}$.

Let $k \in \{1,2,\cdots,n-1\}$ and let $x_k \geq M_k$. Suppose that $x_{k+1} < M_{k+1}$

Then $\sum_{i\leq k} f_i$
$= \sum_{i\leq k}\left[\sum_{j\in O_i: j\leq k} E(x_i,x_j) - \sum_{j\in O_i: j\leq k} S(i,j) + \sum_{j\in O_i: j>k} E(x_i,x_j) - \sum_{j\in O_i: j>k} S(i,j) + E(x_i,r_i) - 1\right]$
$> \sum_{i\leq k}\left[\sum_{j\in O_i: j\leq k} E(x_i,x_j) - \sum_{j\in O_i: j\leq k} S(i,j) + \sum_{j\in O_i: j>k} E(M_k, M_{k+1}) - \sum_{j\in O_i: j>k} 2 + E(M_k, \max(r)) - 1\right]$
$\geq \sum_{i\leq k}\left[\sum_{j\in O_i: j\leq k} E(x_i,x_j) - \sum_{j\in O_i: j\leq k} S(i,j) + gE(M_k, M_{k+1}) - 2g + E(M_k, \max(r)) - 1\right]$
$= \sum_{i\leq k}\left[\sum_{j\in O_i: j\leq k} E(x_i,x_j) - \sum_{j\in O_i: j\leq k} S(i,j)\right]$
$= \sum_{i\leq k}\sum_{j\in O_i: j\leq k} E(x_i,x_j) - \sum_{i\leq k}\sum_{j\in O_i: j\leq k} S(i,j)$
$\overset{*}{=} \frac{1}{2}\sum_{i\leq k}\sum_{j\in O_i: j\leq k} 2 - \frac{1}{2}\sum_{i\leq k}\sum_{j\in O_i: j\leq k} 2 = 0$

* Since for $i \leq k$ and $j \leq k$ it holds that if $i \leq k$ is an opponent of j, then $j \leq k$ is also an opponent of i. Since $E(x_i, x_j) + E(x_j, x_i) = 2$ and since $S(i,j) + S(j,i) = 2$ it holds that $\sum_{i \leq k} \sum_{j \in O_i : j \leq k} E(x_i, x_j)$ is equal to the number of games played between k players with the highest ratings. The same holds for $\sum_{i \leq k} \sum_{j \in O_i : j \leq k} S(i,j)$.

$\sum_{i \leq k} f_i > 0$ is in contradiction with $\sum_{i \in N} f_i = 0$. Hence, $\forall k \in \{1,2,\cdots,n-1\}$ it holds that $x_k \geq M_k \Rightarrow x_{k+1} \geq M_{k+1}$

Now suppose that in a solution $x_1 > M_1$, then by induction it also holds that $x_i \geq M_n \; \forall i \in \{1,2,\cdots,n\}$. Consequently, $x_i \geq \max(\boldsymbol{r}) \; \forall \; i \in \{1,2,\cdots,n\}$ and $\sum_{i \in N}[E(x_i, r_i) - 1] > 0$.

Again, this is a in contradiction with $\sum_{i \in N} f_i = \sum_{i \in N} \sum_{j \in O_i} E(x_i, x_j) - s_i + E(x_i, r_i) - 1 = 0$ since because of the fact that $E(a,b) + \; E(b,a) = 2$ it holds that $\sum_{i \in N} \sum_{j \in O_i} E(\, x_i, x_j) = \sum_{i \in N} s_i$. Consequently, in a solution $\sum_{i \in N}[E(x_i, r_i) - 1] = 0$ would hold.

Hence, in a solution $x_i \leq M_{1.}$ In the same way we can find that $x_i \geq L_{n.}$ $|x_i| \leq \max\,(-L_n, M_1)$. The collection V of $\boldsymbol{x}$ defined by $|x_i| \leq \max(-L_n, M_1) \; \forall i \in N$ is compact.

Secondly, we define the objective function z. Define $z(\boldsymbol{x}) = \sum_{i \in N} |f_i|$. Ovbiously, $z(\boldsymbol{x}) \geq 0$ and z is a continuous function.

Let $\boldsymbol{x} \in V: z(\boldsymbol{x}) > 0$. There exists a player h for whom $f_h > 0$ or there exists a player h for whom $f_h < 0$. For the case that $f_h < 0$ we show that we can improve z. That we can improve z if there is a player for whom $f_h > 0$ can be shown in a similar way.

We show that if there exists a player h for whom $f_h < 0$, then there exists a player k for whom both $f_k < 0$ and $x_k < M_1$.

Let h be a player such that $f_h < 0$. Suppose that there would not be a player for whom $f_k < 0$ and $x_k < M_1$. Then $x_h = M_n$. Without loss of generality we can state that player h is player 1 with rating x_1. In the same way as we have shown that in a solution $x_i \geq M_i$ implies that $x_{i+1} \geq M_{i+1}$ we can conclude that $x_1 = M_1$ implies that $x_i \geq M_i \; \forall i \in N$, given the assumption that $f_k \geq 0$ for players with $x_k < M_1$.

Consequently all players would have ratings higher than max(r), which is in contradiction with the assumption that $f_k < 0$. Hence, there exists a player for whom $f_k < 0$ and $x_k < M_1$. In the same way we can conclude that if there exists a player h for whom $f_h > 0$, it also holds that there is a player k for whom both $f_k > 0$ and $x_k > L_n$.

We define T_k as the solution of $f_k(\boldsymbol{x}) = \sum_{j \in O_k} E(T_k, x_j) - s_k + E(T_k, r_k) - 1 = 0$. Define x'_i as x_i if $i \neq k$ and $x_i = \min\,(\max(L_n, T)\,, M_1)$ if $i = k$

For a player k for whom $f_k > 0$ we show that we can improve the objective function with $'$.

Since $E(a,b) > E(a + \varepsilon, b) \; \forall \; \varepsilon > 0$ and $x_k > x'_k$ it holds that
$\sum_{i \in O_k} E(x'_k, x_i) - s_k + E(x_k, r_k) - 1 > \sum_{i \in O_k} E(x'_k, x_i) - s_k + E(x'_k, r_k) - 1$.

Since $E(a,b) + E(b,a) = 2$ it also holds that
$\sum_{i \in O_k} 2 - \; E(x_i, x'_k) - s_k + E(x_k, r_k) - 1 > \sum_{\square \in O_k} E(x'_k, x_i) - s_k + E(x'_k, r_k) - 1$

and also
$\sum_{i \in O_k} E(x_k, x_i) + E(x_i, x_k) - \; E(x_i, x'_k) - s_k + E(x_k, r_k) - 1 > \sum_{i \in O_k} E(x', x_i) - s_k + E(x'_k, r_k) - 1$.

Since $f_k(\boldsymbol{x}) > 0$ and $E(a,b) > E(a,b+\varepsilon)\ \forall\ \varepsilon > 0$ and $x_k > x'_k$, it holds that
$\left|\sum_{i\in O_k} E(x_k,x_i) - s_k + E(x_k,r_k) - 1\right| - \sum_{i\in O_k}|E(x_i,x'_k) - E(x_i,x_k)| > \sum_{i\in O_k} E(x'_k,x_i) - s_k + E(x'_k,r_k) - 1$

or equivalently,
$\left|\sum_{i\in O_k} E(x_k,x_i) - s_k + E(x_k,r_k) - 1\right| > \sum_{i\in O_k}|E(x_i,x'_k) - E(x_i,x_k)| + \sum_{i\in O_k} E(x'_k,x_i) - s_k + E(x'_k,r_k) - 1$.

Adding $\sum_{i\in O_k}\left|\sum_{j\in O_i\backslash k} E(x_i,x_j) + E(x_i,x_k) - s_i + E(x_i,r_i) - 1\right|$ on both sides and using the triangular inequality gives
$\left|\sum_{i\in O_k} E(x_k,x_i) - s_k + E(x_k,r_k) - 1\right| + \sum_{i\in O_k}\left|\sum_{j\in O_i\backslash k} E(x_i,x_j) + E(x_i,x_k) - s_i + E(x_i,r_i) - 1\right|$
$>$
$\sum_{i\in O_k}\left|\sum_{j\in O_i\backslash k} E(x_i,x_j) + E(x_i,x_k) - s_i + E(x_i,r_i) - 1\right| + \sum_{i\in O_k}|E(x_i,x'_k) - E(x_i,x_k)| + \sum_{i\in O_k} E(x'_k,x_i) - s_k + E(x'_k,r_k) - 1$
$\geq$
$\sum_{i\in O_k}\left|\sum_{j\in O_i\backslash k} E(x_i,x_j) + E(x_i,x_k) - s_i + E(x_i,r_i) - 1 + E(x_i,x'_k) - E(x_i,x_k)\right| + \sum_{i\in O_k} E(x'_k,x_i) - s_k + E(x'_k,r_k) - 1$.

Hence,
$\sum_{i\in O_k}|E(x_k,x_i) - s_k + E(x_k,r_k) - 1| + \sum_{i\in O_k}\left|\sum_{j\in O_i\backslash k} E(x_i,x_j) + E(x_i,x_k) - s_i + E(x_i,r_i) - 1\right|$
$> \sum_{i\in O_k}\left|\sum_{j\in O_i\backslash k} E(x_i,x_j) + E(x_i,x'_k) - s_i + E(x_i,\square_i) - 1\right| + \sum_{i\in O_k}|E(x'_k,x_i) - s_k + E(x'_k,r_k) - 1|$

or equivalently, $z(\boldsymbol{x}) > z(\boldsymbol{x}')$.

In a similar way we can prove that $z(\boldsymbol{x}) > z(\boldsymbol{x}')$ if $f_k(\boldsymbol{x}) = \sum_{j\in O_k} E(x_k,x_j) - s_k + E(x_k,r_k) - 1 < 0$ defining x'_i as x_i if $i \neq k$ and $x_i = \min\,(M_1,T_k)$ if $i = k$.

Consequently, if there exists a minimum, the minimum should be equal to zero. According to Weierstrass (Kaper and Norde 1996) there exists an $\boldsymbol{x}^* \in V$ such that $z(\boldsymbol{x}^*) \leq z(\boldsymbol{x})\ \forall \boldsymbol{x} \in V$. Hence $z(\boldsymbol{x}^*) = 0$, otherwise there would be a $\boldsymbol{x}^{*\prime} \in V$ for which $z(\boldsymbol{x}^{*\prime}) < z(\boldsymbol{x}^*)$ which is in contradiction with $z(\boldsymbol{x}^*) \leq z(\boldsymbol{x})\ \forall \boldsymbol{x} \in V$. Hence there exists a solution to the set of equations.

□

Moreover, we prove that the solution is unique.

Theorem:

The solution $\boldsymbol{x}^*$ that solves the system of equations is unique.

Suppose $\boldsymbol{x}^\circ \neq \boldsymbol{x}^*$ solves the system of equations as well. Let j be a player who minimizes $x_i^\circ - x_i^*$. Because $\sum_{i\in N} E\left(x_i^\circ,r_i\right) = \sum_{i\in N} E(x_i^*,r_i) = n$ and we have $x_i^\circ < x_i^*$ it holds that $E\left(x_i^\circ,r_i\right) < E(x_i^*,r_i)$ and furthermore, for all $i \in O_j$ we have $E\left(x_j^\circ,x_i^\circ\right) = E\left(x_j^\circ - \left(x_j^\circ - x_j^*\right), x_i^\circ - \left(x_j^\circ - x_j^*\right)\right) \leq E\left(x_j^*, x_i^\circ - \left(x_i^\circ - x_i^*\right)\right) = E\left(x_j^*,x_i^*\right)$
Hence, $0 = f_j(\boldsymbol{x}^\circ) < f_j(\ \boldsymbol{x}^*) = 0$. Contradiction. The solution $\boldsymbol{x}^*$ is unique.

□

Appendix 3

Running scores after five rounds and explanation Swiss ranking system

Round Robin

The Tie-breaking criteria are, according to Annex 3 of the FMJD (FMJD 2007), laid down by the particular regulations of the World Championship since advantageous draws are used.

Pl	Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Pt	W	+	-
1	Chizhov	X	.	.	.	1	.	2	.	1	.	.	.	.	.	.	.	2	.	.	2	8	3	0	0
2	Podolskij	.	X	1	.	.	.	.	.	.	.	.	.	.	.	2	2	.	1	1+	.	7	2	1	0
3	Vd Akker	.	1	X	.	.	.	.	1	.	.	.	.	.	.	.	2	.	1	2	.	7	2	0	0
4	Mikhalchenka	.	.	.	X	.	.	.	0	.	.	.	1	1	.	2	.	.	.	2	.	6	2	0	0
5	Misans	1	.	.	.	X	.	1-	.	.	1	.	.	.	.	.	.	1	.	.	2	6	1	0	1
	Domchev	.	.	.	.	.	X	.	.	1	1-	1	.	.	1	.	.	.	.	.	2	6	1	0	1
7	Schwarzman	0	.	.	.	1+	.	X	.	.	.	1	.	.	.	.	.	1	.	.	2	5	1	1	0
8	Thijssen	.	.	1	2	.	.	.	X	.	.	.	1	1	.	0	.	.	.	.	.	5	1	0	0
9	Anikeev	1	.	.	.	.	1	.	.	X	1+	1	.	.	1	.	.	.	.	.	.	5	0	1	0
10	Lagoda	.	.	.	.	1	1+	.	.	1-	X	1	.	.	1	.	.	.	.	.	.	5	0	1	1
11	Amrillaew	.	.	.	.	.	1	1	.	1	1	X	.	.	1	.	.	.	.	.	.	5	0	0	0
	Kouogueu	.	.	.	1	.	.	.	1	.	.	.	X	1	.	1	1	.	.	.	.	5	0	0	0
	Samb	.	.	.	1	.	.	.	1	.	.	.	1	X	.	1	.	.	1	.	.	5	0	0	0
14	Georgiev	.	.	.	.	.	1	.	.	1	1	1	.	.	X	.	.	1-	.	.	.	5	0	0	1
15	Pierre	.	0	.	0	.	.	.	2	.	.	.	1	1	.	X	.	.	.	.	.	4	1	0	0
	Scholma	.	0	0	.	.	.	.	.	.	.	.	1	.	.	.	X	.	2	1	.	4	1	0	0
17	Valneris	0	.	.	.	1	.	1	.	.	.	.	.	.	1+	.	.	X	.	.	1+	4	0	2	0
18	Ndjofang	.	1	1	.	.	.	.	.	.	.	.	.	1	.	.	0	.	X	1+	.	4	0	1	0
19	Ba	.	1-	0	0	.	.	.	.	.	.	.	.	.	.	.	1	.	1-	X	.	3	0	0	2
20	Tuvshinbold	0	.	.	.	0	0	0	.	.	.	.	.	.	.	.	.	1-	.	.	X	1	0	0	1

Table A3.1 Round Robin

The criteria of the WC are as follows:

1) The largest number of victories
2) The largest positive difference between advantageous draws and disadvantageous draws
3) The largest number of advantageous draws

Example Round Robin

Chizhov is the only player with 8 points, therefore he is ranked first. Podolskij and Vd Akker both scored 7 points with both two victories. Since Podolskij scored an advantageous draw he is ranked second and Vd Akker is ranked third. There are three players with 6 points, Mikhalchenka is the only player with 6 points that scored more than one victory, and therefore he is ranked fourth. Et cetera.

Solkoff

As Tie-breaking criteria we use Annex 3 of the FMJD. (FMJD 2007)

Pl	Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Pt	SkM	SkT	SkT2	SkT3	SkT4
1	Chizhov	X	.	.	.	1	.	1	.	.	2	.	.	.	.	2	.	.	.	.	2	8	14	20	16	11	6
2	Vd Akker	.	X	1	.	.	.	.	1	.	.	.	.	.	.	.	2	1	.	2	.	7	13	20	16	12	7
3	Podolskij	.	1	X	.	.	.	.	.	.	.	.	.	.	.	.	2	1	2	1	.	7	12	19	15	11	7
4	Domchev	.	.	.	X	.	.	1	.	1	.	1	1	.	.	.	.	.	.	.	2	6	15	20	15	10	5
5	Misans	1	.	.	.	X	.	.	.	1	1	.	.	.	.	1	.	.	.	.	2	6	14	22	18	13	8
6	Mikhalchenka	.	.	.	.	.	X	.	0	.	.	.	.	1	1	.	.	.	2	2	.	6	14	19	15	10	5
7	Anikeev	1	.	.	1	.	.	X	.	1	.	1	1	.	.	.	.	.	.	.	.	5	16	24	19	14	8
8	Thijssen	.	1	.	.	.	2	.	X	.	.	.	.	1	1	.	.	.	0	.	.	5	16	23	18	13	7
9	Lagoda	.	.	.	1	1	.	1	.	X	.	1	1	.	.	.	.	.	.	.	.	5	16	22	17	12	6
10	Schwarzman	0	.	.	.	1	.	.	.	.	X	.	1	.	.	1	.	.	.	.	2	5	15	23	19	14	8
11	Amrillaew	.	.	.	1	.	.	1	.	1	.	X	1	.	.	1	.	.	.	.	.	5	15	21	16	11	6
	Georgiev	.	.	.	1	.	.	1	.	1	1	1	X	.	.	.	.	.	.	.	.	5	15	21	16	11	6
13	Samb	.	.	.	.	.	1	.	1	.	.	.	.	X	1	.	1	.	1	.	.	5	14	20	16	11	6
	Kouogueu	.	.	.	.	.	1	.	1	.	.	.	.	1	X	.	.	1	1	.	.	5	14	20	16	11	6
15	Valneris	0	.	.	.	1	.	.	.	.	1	1	.	.	.	X	.	.	.	.	1	4	16	24	19	14	8
16	Ndjofang	.	0	0	.	.	.	.	.	.	.	.	.	1	.	.	X	2	.	1	.	4	16	23	19	14	7
	Scholma	.	1	1	.	.	.	.	.	.	.	.	.	.	1	.	0	X	.	1	.	4	16	23	19	14	7
18	Pierre	.	.	0	.	.	0	.	2	.	.	.	.	1	1	.	.	.	X	.	.	4	16	23	18	13	7
19	Ba	.	0	1	.	.	0	.	.	.	.	.	.	.	.	.	1	1	.	X	.	3	17	24	20	14	7
20	Tuvshinbold	0	.	.	0	0	.	.	.	.	0	.	.	.	.	1	.	.	.	.	X	1	17	25	20	14	8

Table A3.2 Solkoff

1) Median Solkoff: the largest total score of opponents played, not counting the strongest and the weakest score
2) Truncated Solkoff: the largest total score of opponents played, not counting the weakest, if needed the second weakest etc.

Example Solkoff

Chizhov is the only player with 8 points, therefore he is ranked first. Podolskij and Vd Akker both scored 7 points. We apply Median Solkoff:

Podolskij played against Vd Akker, Ndjofang, Scholma Pierre and Ba. Vd Akker has the strongest score, Ba the weakest. Ndjofang, Scholma and Pierre all scored 4 points which results in a Median Solkoff score of 3x4=12

Vd Akker played against Podolskij, Thijssen, Scholma, Pierre and Ba. Podolskij has the strongest score, Ba the weakest. Thijssen, Scholma and Pierre scored respectively 5, 4 and 4 points, which results in a Median Solkoff score of 5+4+4=13

Thus, Podolskij scored 12 and Vd Akker scored 13 on Median Solkoff. Therefore Vd Akker is ranked second and Podolskij is ranked third.

In the same way Domchev is ranked fourth, above Misans and Mikhalchenka. Misans and Mikhalchenka both scored 14. Since Median Solkoff does not break the tie we need to apply Truncated Solkoff. Using Truncated Solkoff we find that Misans scored 8+5+5+4=22 and that Mikhalchenka scored 5+5+5+4=19. Therefore Misans is ranked fifth and Mikhalchenka is ranked sixth. Et cetera.

Buchholz

The Swiss system on Buchholz is not mentioned in Annex 3 of the FMJD, therefore we use the Tie-breaking criteria of the Handbook of the KNDB (KNDB 2005).

Pl	Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Pt	B	SB
1	Chizhov	X	.	.	1	.	.	1	.	.	.	.	.	.	2	.	.	.	2	.	2	8	21	31
2	Vd Akker	.	X	1	.	.	.	.	1	.	.	.	.	.	.	.	1	2	.	2	.	7	23	30
3	Podolskij	.	1	X	.	.	.	.	.	.	.	.	.	.	.	2	1	2	.	1	.	7	22	30
4	Misans	1	.	.	X	.	.	.	.	1	.	.	.	.	1	.	.	.	1	.	2	6	23	24
5	Mikhalchenka	.	.	.	.	X	.	.	0	.	.	.	1	1	.	2	.	.	.	2	.	6	22	24
6	Domchev	.	.	.	.	.	X	1	.	1	1	1	.	.	.	.	.	.	.	.	2	6	21	22
7	Anikeev	1	.	.	.	.	1	X	.	1	1	1	.	.	.	.	.	.	.	.	.	5	29	29
8	Thijssen	.	1	.	.	2	.	.	X	.	.	.	1	1	.	0	.	.	.	.	.	5	27	29
9	Lagoda	.	.	.	1	.	1	1	.	X	1	1	.	.	.	.	.	.	.	.	.	5	27	27
10	Amrillaew	.	.	.	.	.	1	1	.	1	X	1	.	.	1	.	.	.	.	.	.	5	26	26
11	Georgiev	.	.	.	.	.	1	1	.	1	1	X	.	.	.	.	.	.	1	.	.	5	25	25
12	Kouogueu	.	.	.	.	1	.	.	1	.	.	.	X	1	.	1	.	1	.	.	.	5	24	24
13	Samb	.	.	.	.	1	.	.	1	.	.	.	1	X	.	1	1	.	.	.	.	5	24	24
14	Schwarzman	0	.	.	1	.	.	.	.	.	1	.	.	.	X	.	.	.	1	.	2	5	24	17
15	Pierre	.	.	0	.	0	.	.	2	.	.	.	1	1	.	X	.	.	.	.	.	4	28	20
16	Ndjofang	.	1	1	.	.	.	.	.	.	.	.	.	1	.	.	X	0	.	1	.	4	26	22
17	Scholma	.	0	0	.	.	.	.	.	.	.	.	1	.	.	.	2	X	.	1	.	4	26	16
18	Valneris	0	.	.	1	.	.	.	.	.	.	1	.	.	1	.	.	.	X	.	1	4	25	17
19	S Ba	.	0	1	.	0	.	.	.	.	.	.	.	.	.	.	1	1	.	X	.	3	28	15
20	Tuvshinbold	0	.	.	0	.	0	.	.	.	.	.	.	.	0	.	.	.	1	.	X	1	29	4

Table A3.3 Buchholz

1) Buchholz: the largest total score of opponents played
2) Sonnenbergh: the largest total score of opponents score multiplied with the individual result against the corresponding opponent

Example Buchholz

Chizhov is the only player with 8 points, therefore he is ranked first. Podolskij and Vd Akker both scored 7 points. We apply Buchholz:

Vd Akker played against Podolskij, Thijssen, Pierre, Ndjofang and Ba. They scored respectively 7, 5, 4, 4, 3 points, which sum up to 23 points. Podolskij played against Vd Akker, Pierre, Ndjofang, Scholma and Ba. They scored respectively 7, 4, 4, 4, 3 points, which sum up to 22 points.

Therefore Vd Akker is ranked second and Podolskij is ranked third. Thijssen and Lagoda both scored 5 points. Buchholz does not break the tie. We apply Sonnenbergh:

Thijssen scored 2 points against Mikhalchenka (6pt), scored 1 point against Vd Akker (7pt), Kouougue (5pt), and Samb (5pt) and scored 0 points against Pierre (4pt) Which results in a Sonnenbergh score of 2x6 + 1x(7+5+5) + 0x4 = 29. Lagoda scored only draws, which means that the Sonnenbergh-score equals the Buchholz-score (=27). Therefore Thijssen is ranked higher than Lagoda. Et cetera.

Rating

As Tie-breaking criteria we use the Annex 3 of the FMJD (FMJD 2007)

Pl	Name	Rating	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Pt	AOR
1	Chizhov	2449	X	.	.	1	.	.	1	.	.	2	.	.	.	.	.	2	.	.	.	2	8	2328,0
2	Vd Akker	2324	.	X	1	.	.	.	.	.	.	.	.	.	.	1	.	.	2	1	2	.	7	2352,8
3	Podolskij	2438	.	1	X	.	.	.	.	.	.	.	.	.	.	.	2	.	2	1	1	.	7	2298,2
4	Misans	2341	1	.	.	X	.	.	.	.	1	1	.	.	.	.	.	1	.	.	.	2	6	2344,2
5	Domchev	2316	.	.	.	.	X	.	1	1	1	.	1	.	.	.	.	.	.	.	.	2	6	2309,4
6	Mikhalchenka	2344	.	.	.	.	.	X	.	.	.	.	.	1	1	0	2	.	.	.	2	.	6	2306,4
7	Anikeev	2328	1	.	.	.	1	.	X	1	1	.	1	.	.	.	.	.	.	.	.	.	5	2361,8
8	Amrillaew	2305	.	.	.	.	1	.	1	X	1	1	1	.	.	.	.	.	.	.	.	.	5	2358,6
9	Lagoda	2301	.	.	.	1	1	.	1	1	X	.	1	.	.	.	.	.	.	.	.	.	5	2345,6
10	Schwarzman	2410	0	.	.	1	.	.	.	1	.	X	.	.	.	.	.	1	.	.	.	2	5	2331,2
11	Georgiev	2438	.	.	.	.	1	.	1	1	1	.	X	.	.	.	.	1	.	.	.	.	5	2327,2
12	Samb	2341	.	.	.	.	.	1	.	.	.	.	.	X	1	1	1	.	.	1	.	.	5	2325,6
13	Kouogueu	2355	.	.	.	.	.	1	.	.	.	.	.	1	X	1	1	.	1	.	.	.	5	2315,8
14	Thijssen	2362	.	1	.	.	.	2	.	.	.	.	.	1	1	X	0	.	.	.	.	.	5	2313,4
15	Pierre	2203	.	.	0	.	.	0	.	.	.	.	.	1	1	2	X	.	.	.	.	.	4	2368,0
16	Valneris	2386	0	.	.	1	.	.	.	.	.	1	1	.	.	.	.	X	.	.	.	1	4	2362,6
17	Scholma	2329	.	0	0	.	.	.	.	.	.	.	.	.	1	.	.	.	X	2	1	.	4	2350,4
18	Ndjofang	2364	.	1	1	.	.	.	.	.	.	.	.	1	.	.	.	.	0	X	1	.	4	2340,6
19	S Ba	2271	.	0	1	.	.	0	.	.	.	.	.	.	.	.	.	.	1	1	X	.	3	2359,8
20	Tuvshinbold	2175	0	.	.	0	0	.	.	.	.	0	.	.	.	.	.	1	.	.	.	X	1	2380,4

Table A3.4 Rating

1) For the first place: first the result between the tied players
2) The highest average rating of the opponents

Example Rating

Chizhov is the only player with 8 points, therefore he is ranked first. Podolskij and Vd Akker both scored 7 points. We compute the average opponents rating:

Vd Akker played against Podolskij (2438), Thijssen (2362), Pierre (2203), Ndjofang (2364) and Ba (2271) which gives an average opponents rating of (2438+2362+2203+2364+2271)/5=2352.8

Podolskij played against Vd Akker (2324), Pierre (2203), Ndjofang (2364), Scholma (2329) and Ba (2271) which gives an average opponents rating of (2324+2203+2364+2329+2271)/5=2298.2

Since Vd Akker has the highest average opponents rating he is ranked second and consequently Podolskij is ranked third. Et cetera.

Appendix 4

Ranking table WC 2007 Pairings round robin

Name	System	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6	Round 7	Round 8	Round 9	Round 10
Lagoda	RR	6-15	6-13	13-15	12-14	10	11	6	11	15	16
	SOLKOFF	5-16	8-16	10-13	13	9	8-9	9	11-12	14-15	16
	B/SB	5-16	8-13	9-11	10-12	9	8-9	10	15	16	16
	RATING	10-11	12	12	8	9	8	9	11	14	16
	STPR	14	12	10	12	9	9	10	12	15	16
Amrilaew	RR	6-15	6-13	9-12	9-11	11-13	6	7-8	8	8-9	10-11
	SOLKOFF	5-16	8-16	7-9	10-12	11-12	6	5	6	6-7	6
	B/SB	5-16	8-13	7-8	8-9	10	7	6-7	6	9-10	7
	RATING	13	15	11	10	8	7	8	6	6	6
	STPR	16	14	8	11	10	6	9	6	7	6
Anikeev	RR	6-15	6-13	8	8	9	5	13	12	12	12
	SOLKOFF	5-16	8-16	10-13	10-12	7	4-5	11	10	11-12	12
	B/SB	5-16	8-13	9-11	8-9	7	4	11	10	11	12
	RATING	5-6	7	8	9	7	4	11	10	11	12
	STPR	7	10	12	10	5	4	8	7	12	12
Georgiev	RR	6-15	14-16	13-15	12-14	14	14	9-10	5	5	5
	SOLKOFF	5-16	8-16	10-13	10-12	11-12	8-9	4	2-3	3-4	4
	B/SB	5-16	14-16	13	10-12	11	8-9	4	3	3	4
	RATING	12	8	10	11	11	12	4	4	4	4
	STPR	5	8	11	9	8	7	2	3	3	4
Domchev	RR	6-15	6-13	9-12	5-6	5-6	7	9-10	9	10	10-11
	SOLKOFF	5-16	8-16	10-13	5	4	4-5	6	7	6-7	9
	B/SB	5-16	8-13	9-11	5	6	5	6-7	9	9-10	11
	RATING	14	14	7	5	5	5	7	7	7	9
	STPR	15	13	13	7	6	5	7	8	6	11
Misans	RR	6-15	14-16	13-15	12-14	5-6	10	14	14	13	13
	SOLKOFF	5-16	5-7	6	8-9	5	11-12	13	11-12	11-12	13
	B/SB	5-16	5-7	6	7	4	11	15	14	13	13
	RATING	15	9	6	7	4	11	13	12	12	13
	STPR	12	7	5	6	4	12	13	11	11	13
Schwarzman	RR	1-4	2	3-4	7	7	8-9	4-5	2-3	4	1-2
	SOLKOFF	1-4	2-4	4	8-9	10	11-12	8	4	3-4	3
	B/SB	1-4	4	4	13	14	12	8	5	5	3
	RATING	4	4	5	13	10	9	5	2	3	2
	STPR	2	4	4	8	12	11	5	4	4	3

Table A4 Pairing of round robin

Name	System	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6	Round 7	Round 8	Round 9	Round 10
Chizhov	RR	1-4	1	1-2	1	1	1-2	1-2	4	1	1-2
	SOLKOFF	1-4	1	2	1	1	1	1	2-3	1	1
	B/SB	1-4	1	2	1	1	2	3	4	2	2
	RATING	1	1	2	1	1	2	1	3	1	1
	STPR	1	1	2	1	1	1	1	2	1	1
Valneris	RR	17-20	17	16	16	17	17	17	16	16	15
	SOLKOFF	17-20	17	17	17	15	17	16	16	14-15	14
	B/SB	17-20	17	18	17	18	17	16	16	14	14
	RATING	17	17	18	16	16	15	16	16	15	14
	STPR	17	15	18	16	16	17	16	16	14	14
Otgonbayar	RR	17-20	20	20	20	20	20	20	20	20	20
	SOLKOFF	17-20	20	19	20	20	20	20	20	20	20
	B/SB	17-20	20	19	20	20	20	20	20	20	20
	RATING	18	20	19	20	20	20	20	20	20	20
	STPR	20	20	19	20	20	20	20	20	20	20
Ndjofang	RR	6-15	6-13	17	17	18	8-9	4-5	7	11	6
	SOLKOFF	5-16	8-16	18	15	16-17	10	7	8-9	13	11
	B/SB	5-16	8-13	17	15	16	10	5	7	12	10
	RATING	10-11	5	16	15	18	10	6	9	13	11
	STPR	10	11	17	15	15	10	6	9	13	10
Podolski	RR	5	5	3-4	2	2	3	3	1	2	3
	SOLKOFF	5-16	8-16	5	3	3	3	3	1	2	2
	B/SB	5-16	8-13	5	3	3	3	1	1	1	1
	RATING	16	13	4	3	3	3	3	1	2	3
	STPR	6	9	6	4	2	3	3	1	2	2
Scholma	RR	17-20	18-19	6-7	15	15-16	15-16	11-12	6	3	4
	SOLKOFF	17-20	18-19	14	16	16-17	15	12	8-9	5	5
	B/SB	17-20	18-19	12	16	17	15	12	8	4	5
	RATING	20	19	13	17	17	16	15	8	5	5
	STPR	18	18	9	17	17	15	12	10	5	5
Akker	RR	1-4	3-4	1-2	3	3	1-2	1-2	2-3	6	7
	SOLKOFF	1-4	2-4	1	2	2	2	2	5	8-10	8
	B/SB	1-4	2-3	1	2	2	1	2	2	8	8
	RATING	2	2	1	2	2	1	2	5	8	7
	STPR	3	2	1	2	3	2	4	5	10	8

Table A4 Pairing of round robin

Name	System	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6	Round 7	Round 8	Round 9	Round 10
Ba	RR	16	14-16	18	19	19	19	18	18	19	19
	SOLKOFF	5-16	8-16	16	18	19	18-19	18	17	19	19
	B/SB	5-16	14-16	16	18	19	18	18	17	19	19
	RATING	5-6	6	17	19	19	19	18	17	19	19
	STPR	13	17	15	18	19	18	18	17	19	18
Samb	RR	6-15	6-13	9-12	9-11	11-13	12-13	15	15	8-9	9
	SOLKOFF	5-16	8-16	15	14	13-14	13	14	15	8-10	10
	B/SB	5-16	14-16	15	14	12-13	13	13	13	6	9
	RATING	7	16	14	12	12	13	12	13	9	10
	STPR	11	16	16	14	14	13	14	15	9	9
Pierre	RR	17-20	18-19	19	18	15-16	18	19	19	17	18
	SOLKOFF	17-20	18-19	20	19	18	18-19	19	19	17-18	18
	B/SB	17-20	18-19	20	19	15	19	19	19	18	18
	RATING	19	18	20	18	15	18	19	19	17	18
	STPR	19	19	20	19	18	19	19	19	18	19
Kouogueu	RR	6-15	6-13	9-12	9-11	11-13	12-13	7-8	13	7	8
	SOLKOFF	5-16	5-7	7-9	7	13-14	14	10	13-14	8-10	7
	B/SB	5-16	5-7	7-8	10-12	12-13	14	9	11	7	6
	RATING	8	10	9	14	13	14	10	15	10	8
	STPR	9	6	7	13	13	14	11	13	8	7
Thijssen	RR	6-15	6-13	5	5-6	8	15-16	16	17	18	17
	SOLKOFF	5-16	5-7	3	4	8	16	17	18	17-18	17
	B/SB	5-16	5-7	3	4	8	16	17	18	17	17
	RATING	9	11	3	4	14	17	17	18	18	17
	STPR	8	5	3	3	11	16	17	18	17	17
Mikhalchenka	RR	1-4	3-4	6-7	4	4	4	11-12	10	14	14
	SOLKOFF	1-4	2-4	7-9	6	6	7	15	13-14	16	15
	B/SB	1-4	2-3	14	6	5	6	14	12	15	15
	RATING	3	3	15	6	6	6	14	14	16	15
	STPR	4	3	14	5	7	8	15	14	16	15

Table A4 Pairing of round robin

Name	System	Round 11	Round 12	Round 13	Round 14	Round 15	Round 16	Round 17	Round 18	Round 19	Final*
Lagoda	RR	18	19	19	19	18	18	19	18	18	18
	SOLKOFF	17	18	19	19	18	18	19	18	18	
	B/SB	18	19	19	19	18	18	19	18	18	
	RATING	17	18	19	19	18	18	18	18	18	
	STPR	19	19	19	19	18	18	18	18	18	
Amrilaew	RR	9	10	10	10	9	8	9	8	7	7
	SOLKOFF	7	7	7	9	5	6	7	7	7	
	B/SB	7	7	7	9	5	6	7	7	7	
	RATING	7	7	7	9	5	5	6	7	7	
	STPR	7	7	7	9	5	6	7	7	7	
Anikeev	RR	11	9	9	7	6	6	8	7	6	5-6
	SOLKOFF	11	8	8	6	6	7	8	8	5-6	
	B/SB	11	8	8	7	7	7	8	8	5	
	RATING	11	8	8	6	6	6	7	8	5	
	STPR	11	9	8	7	7	7	8	8	6	
Georgiev	RR	5	5	5	8	8	7	5	4	3	3
	SOLKOFF	5	6	6	7	7	5	5	3	3	
	B/SB	6	6	6	6	6	5	5	3	3	
	RATING	6	5	6	7	7	7	5	3	3	
	STPR	6	6	6	6	6	5	5	3	3	
Domchev	RR	13	13	14	14	15	17	17	17	16	16
	SOLKOFF	12-13	12	12	14	14	16	17	17	16	
	B/SB	13	12	12	14	14	16	17	17	16	
	RATING	12	12	12	14	14	16	17	17	16	
	STPR	13	12	12	15	15	16	17	17	16	
Misans	RR	12	12	13	13	13	14	13	14	14	9-14
	SOLKOFF	12-13	13	13	12	12	12	12	11	9-14	
	B/SB	12	13	13	12	12	12	12	11	12	
	RATING	13	13	13	12	12	12	12	11	12	
	STPR	12	13	13	12	12	12	12	11	12-13	
Schwarzman	RR	1	1	1	1	1	1-2	1	1	1	1-2
	SOLKOFF	1	2	2	2	2	2	2	1-2	1-2	
	B/SB	2	2	2	2	2	2	2	2	2	
	RATING	1	1	1	1	1	3	2	2	2	
	STPR	2	2	2	2	2	3	2	2	2	

Table A4 Pairing of round robin

Name	System	Round 11	Round 12	Round 13	Round 14	Round 15	Round 16	Round 17	Round 18	Round 19	Final*
Chizhov	RR	3	3	3	3	3	1-2	3	3	4	4
	SOLKOFF	3	3	3	4	3	3	3	4	4	
	B/SB	3	3	3	4	3	3	3	4	4	
	RATING	3	3	3	3	3	2	3	4	4	
	STPR	3	3	3	3	3	2	3	4	4	
Valneris	RR	15	15	16	15	16	13	15	13	9	9-14
	SOLKOFF	14	14	15	15	15	13	15	13-14	9-14	
	B/SB	14	14	15	15	15	13	15	14	9	
	RATING	14	14	15	15	15	13	15	14	9	
	STPR	14	14	15	14	14	13	14	13	9	
Otgonbayar	RR	20	20	20	20	20	20	20	20	20	20
	SOLKOFF	20	20	20	20	20	20	20	20	20	
	B/SB	20	20	20	20	20	20	20	20	20	
	RATING	20	20	20	20	20	20	20	20	20	
	STPR	20	20	20	20	20	20	20	20	20	
Ndjofang	RR	7	8	8	5	4	5	10	10	9	9-14
	SOLKOFF	9	10	10	8	8-9	8	10	12	9-14	
	B/SB	9	10	10	8	9	8	10	12	13	
	RATING	9	10	10	8	9	8	10	12	13	
	STPR	10	11	11	8	8	8	10	12	10	
Podolski	RR	2	2	2	2	2	3	2	2	2	1-2
	SOLKOFF	2	1	1	1	1	1	1	1-2	1-2	
	B/SB	1	1	1	1	1	1	1	1	1	
	RATING	2	2	2	2	2	1	1	1	1	
	STPR	1	1	1	1	1	1	1	1	1	
Scholma	RR	4	4	4	6	5	4	4	5	5	5-6
	SOLKOFF	4	4	5	5	4	4	4	5	5-6	
	B/SB	4	5	5	5	4	4	4	5	6	
	RATING	5	4	4	5	4	4	4	5	6	
	STPR	4	5	5	5	4	4	4	5	5	
Akker	RR	8	7	7	9	10	9	11	12	12	9-14
	SOLKOFF	8	9	9	10	10	10	11	10	9-14	
	B/SB	8	9	9	10	10	10	11	10	10-11	
	RATING	8	9	9	10	10	10	11	10	10-11	
	STPR	8	10	10	10	11	10	11	10	14	

Table A4 Pairing of round robin

Name	System	Round 11	Round 12	Round 13	Round 14	Round 15	Round 16	Round 17	Round 18	Round 19	Final*
Ba	RR	19	17	17	17	14	15	14	15	15	15
	SOLKOFF	19	17	17	17	16	15	14	15	15	
	B/SB	19	17	17	16	16	15	14	15	15	
	RATING	19	17	17	16	16	15	14	15	15	
	STPR	17	17	17	17	16	15	15	15	15	
Samb	RR	6	6	6	4	7	10-11	6-7	9	10	9-14
	SOLKOFF	6	5	4	3	8-9	11	9	9	9-14	
	B/SB	5	4	4	3	8	11	9	9	14	
	RATING	4	6	5	4	8	11	9	9	10-11	
	STPR	5	4	4	4	9	11	9	9	12-13	
Pierre	RR	17	18	18	18	19	19	18	19	19	19
	SOLKOFF	18	19	18	18	19	19	18	19	19	
	B/SB	17	18	18	18	19	19	18	19	19	
	RATING	18	19	18	18	19	19	19	19	19	
	STPR	18	18	18	18	19	19	19	19	19	
Kouogueu	RR	10	11	12	12	12	10	6-7	6	8	8
	SOLKOFF	10	11	11	11	11	9	6	6	8	
	B/SB	10	11	11	11	11	9	6	6	8	
	RATING	10	11	11	11	11	9	8	8	8	
	STPR	9	8	9	11	10	9	6	6	8	
Thijssen	RR	16	16	15	16	17	16	16	16	17	17
	SOLKOFF	16	16	16	16	17	17	16	16	17	
	B/SB	16	16	16	17	17	17	16	16	17	
	RATING	16	16	16	17	17	17	16	17	17	
	STPR	16	16	16	16	17	17	16	16	17	
Mikhalchenka	RR	14	14	11	11	11	12	12	11	11	9-14
	SOLKOFF	15	15	14	13	13	14	13	13-14	9-14	
	B/SB	15	15	14	13	13	14	13	13	10-11	
	RATING	15	15	14	13	13	14	13	12	12	
	STPR	15	15	14	13	13	14	13	14	11	

Table A4 Pairing of round robin

Appendix 5

Running scores after five rounds and pairings of the Swiss systems

Solkoff Swiss pairing

Pl	Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Pt	SkM	SkT	SkT2	SkT3	SkT4
1	Samb	X	1	.	1	1	2	.	.	.	.	.	.	.	2	.	.	.	.	.	.	7	17	24	19	13	7
	Schwarzman	1	X	.	1	1	.	.	.	.	.	.	.	.	.	2	2	.	.	.	.	7	17	24	19	13	7
3	Georgiev	.	.	X	1	1	.	1	.	.	.	.	.	2	.	.	.	2	.	.	.	7	16	22	17	12	6
4	Mikhalchenka	1	1	1	X	.	1	.	.	.	.	.	.	.	.	.	.	.	.	2	.	6	19	26	21	14	7
	Podolskij	1	1	1	.	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	2	6	19	26	21	14	7
6	Valneris	0	.	.	1	1	X	.	.	.	.	.	.	.	1	.	.	2	.	.	.	5	17	24	19	13	7
7	Amrillaew	.	.	1	.	.	.	X	1	1	.	1	.	.	.	.	.	.	1	.	.	5	15	22	17	12	7
8	Ba	.	.	.	.	.	.	1	X	1	1	1	1	.	.	.	.	.	.	.	.	5	15	20	15	10	5
	Scholma	.	.	.	.	.	.	1	1	X	1	1	1	.	.	.	.	.	.	.	.	5	15	20	15	10	5
	Misans	.	.	.	.	.	.	.	1	1	X	.	1	1	.	.	.	1	.	.	.	5	15	20	15	10	5
	Kouogueu	.	.	.	.	.	.	1	1	1	.	X	.	1	.	1	.	.	.	.	.	5	15	20	15	10	5
	Chizhov	.	.	.	.	.	.	.	1	1	1	.	X	.	1	1	.	.	.	.	.	5	15	20	15	10	5
13	Pierre	.	.	0	.	.	.	.	.	.	1	1	.	X	.	.	.	.	2	1	.	5	14	21	17	12	7
	Domchev	0	.	.	.	.	1	.	.	.	.	.	1	.	X	.	1	.	.	.	2	5	14	21	17	12	7
	Anikeev	.	0	.	.	.	.	.	.	.	.	1	1	.	.	X	1	.	2	.	.	5	14	21	17	12	7
16	Vd Akker	.	0	.	.	.	.	.	.	.	.	.	.	.	1	1	X	.	1	1	.	4	14	21	17	12	7
	Ndjofang	.	.	0	.	.	0	.	.	.	1	.	.	.	.	.	.	X	.	2	1	4	14	21	17	12	7
18	Thijssen	.	.	.	.	.	.	1	.	.	.	.	.	0	.	0	1	.	X	.	2	4	14	19	15	10	5
19	Lagoda	.	.	.	0	.	.	.	.	.	.	.	.	1	.	.	1	0	.	X	2	4	13	19	15	11	6
20	Tuvshinbold	.	.	.	.	0	.	.	.	.	.	.	.	.	0	.	.	1	0	0	X	1	13	19	15	11	6

Table A5.1

Buchholz Swiss pairing

Pl	Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Pt	B	SB
1	Samb	X	1	.	1	1	2	.	.	.	.	.	.	.	.	2	.	.	.	.	.	7	29	39
2	Schwarzman	1	X	.	1	1	.	.	.	.	.	.	.	2	.	.	2	.	.	.	.	7	28	37
3	Georgiev	.	.	X	1	1	.	1	.	.	.	.	2	.	.	.	.	2	.	.	.	7	26	35
4	Mikhalchenka	1	1	1	X	.	1	.	.	.	.	.	.	.	.	.	.	.	2	.	.	6	30	34
5	Podolskij	1	1	1	.	X	1	.	.	.	.	.	.	.	.	.	.	.	.	.	2	6	27	28
6	Valneris	0	.	.	1	1	X	.	.	.	.	.	.	.	.	1	.	2	.	.	.	5	28	25
7	Amrillaew	.	.	1	.	.	.	X	1	1	1	.	.	.	.	.	.	.	.	1	.	5	26	26
8	S Ba	.	.	.	.	.	.	1	X	1	1	1	.	.	1	.	.	.	.	.	.	5	25	25
	Scholma	.	.	.	.	.	.	1	1	X	1	1	.	.	1	.	.	.	.	.	.	5	25	25
	Kouogueu	.	.	.	.	.	.	1	1	1	X	.	1	1	.	.	.	.	.	.	.	5	25	25
	Chizhov	.	.	.	.	.	.	.	1	1	.	X	.	1	1	1	.	.	.	.	.	5	25	25
12	Pierre	.	.	0	.	.	.	.	.	.	1	.	X	.	1	.	.	.	1	2	.	5	25	22
	Anikeev	.	0	.	.	.	.	.	.	.	1	1	.	X	.	.	1	.	.	2	.	5	25	22
14	Misans	.	.	.	.	.	.	.	1	1	.	1	1	.	X	.	.	1	.	.	.	5	24	24
15	Domchev	0	.	.	.	.	1	.	.	.	.	1	.	.	.	X	1	.	.	.	2	5	22	16
16	Vd Akker	.	0	.	.	.	.	.	.	.	.	.	.	1	.	1	X	.	1	1	.	4	25	18
17	Ndjofang	.	.	0	.	.	0	.	.	.	.	.	.	.	1	.	.	X	2	.	1	4	22	14
18	Lagoda	.	.	.	0	.	.	.	.	.	.	.	1	.	.	.	1	0	X	.	2	4	20	11
	Thijssen	.	.	.	.	.	.	1	.	.	.	.	0	0	.	.	1	.	.	X	2	4	20	11
20	Tuvshinbold	.	.	.	.	0	.	.	.	.	.	.	.	.	.	0	.	1	0	0	X	1	23	4

Table A5.2

Rating Swiss pairing

Pl	Name	Rating	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Pt	AOR
1	Podolskij	2438	X	.	1	.	1	.	.	1	.	.	.	.	.	.	.	.	2	2	.	.	7	2374,2
2	Ndjofang	2364	.	X	1	.	1	2	1	.	.	2	.	.	.	.	.	.	.	.	.	.	7	2364,8
3	Chizhov	2449	1	1	X	1	.	.	.	.	.	1	.	.	.	.	.	2	.	.	.	.	6	2365,6
4	Misans	2341	.	.	1	X	1	.	.	.	.	1	.	1	.	.	.	.	.	.	.	2	6	2363,2
5	Schwarzman	2410	1	1	.	1	X	.	.	.	.	1	.	.	2	.	.	.	.	.	.	.	6	2362,2
6	Domchev	2316	.	0	.	.	.	X	.	.	.	.	.	.	.	1	1	.	.	2	.	2	6	2328,4
7	Amrillaew	2305	.	1	.	.	.	.	X	.	.	.	.	1	.	1	1	.	.	1	.	.	5	2381,0
8	Anikeev	2328	1	.	.	.	.	.	.	X	1	.	1	1	.	1	.	.	.	.	.	.	5	2366,8
9	Ba	2271	.	.	.	.	.	.	.	1	X	.	.	.	.	1	1	1	.	1	.	.	5	2354,4
10	Mikhalchenka	2344	.	0	1	1	1	.	.	.	.	X	.	.	.	.	.	.	.	.	2	.	5	2353,4
11	Lagoda	2301	.	.	.	.	.	.	.	1	.	.	X	.	.	1	1	.	2	0	.	.	5	2352,0
12	Georgiev	2438	.	.	.	1	.	.	1	1	.	.	.	X	1	.	.	.	1	.	.	.	5	2325,4
13	Vd Akker	2324	.	.	.	.	0	.	.	.	.	.	.	1	X	.	1	.	.	.	2	1	5	2317,6
14	Valneris	2386	.	.	.	.	.	1	1	1	1	.	1	.	.	X	.	.	.	.	.	.	5	2304,2
15	Thijssen	2362	.	.	.	.	.	1	1	.	1	.	1	.	1	.	X	.	.	.	.	.	5	2303,4
16	Samb	2341	.	.	0	.	.	.	.	.	1	.	.	.	.	.	.	X	1	.	1	2	5	2285,4
17	Scholma	2329	0	.	.	.	.	.	.	.	.	.	0	1	.	.	.	1	X	.	2	.	4	2344,2
18	Kouogueu	2355	0	.	.	.	.	0	1	.	1	.	2	.	.	.	.	.	.	X	.	.	4	2326,2
19	Pierre	2203	.	.	.	.	.	.	.	.	.	0	.	.	0	.	.	1	0	.	X	2	3	2302,6
20	Tuvshinbold	2175	.	.	.	0	.	0	.	.	.	.	.	.	1	.	.	0	.	.	0	X	1	2305,0

Table A5.3

STPR Swiss pairing ‘Rating’

Pl	Name	Rating	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	St. PR	Pt
1	Ndjofang	2364	X	.	1	1	.	2	2	1	.	.	.	.	.	.	.	.	.	.	.	.	2540,23	7
2	Podolskij	2438	.	X	1	1	.	.	.	.	1	.	.	.	.	2	.	.	.	2	.	.	2518,74	7
3	Chizhov	2449	1	1	X	.	1	1	.	.	.	.	.	.	.	.	.	.	2	.	.	.	2494,26	6
4	Schwarzman	2410	1	1	.	X	1	1	.	.	.	.	.	.	.	.	.	2	.	.	.	.	2490,08	6
5	Misans	2341	.	.	1	1	X	1	.	.	.	.	1	.	.	.	.	.	.	.	.	2	2423,53	6
6	Mikhalchenka	2344	0	.	1	1	1	X	.	.	.	.	.	.	.	.	.	.	.	.	2	.	2404,79	5
7	Domchev	2316	0	.	.	.	.	.	X	.	.	1	.	1	.	2	.	.	.	.	.	2	2379,96	6
8	Amrillaew	2305	1	.	.	.	.	.	.	X	.	1	1	1	.	1	.	.	.	.	.	.	2363,95	5
9	Anikeev	2328	.	1	.	.	.	.	.	.	X	1	1	.	1	.	1	.	.	.	.	.	2362,22	5
10	Valneris	2386	.	.	.	.	.	.	1	1	1	X	.	.	1	.	1	.	.	.	.	.	2353,89	5
11	Georgiev	2438	.	.	.	.	1	.	.	1	1	.	X	.	.	.	.	1	.	1	.	.	2349,43	5
12	Thijssen	2362	.	.	.	.	.	.	1	1	.	.	.	X	1	.	1	1	.	.	.	.	2333,66	5
13	Lagoda	2301	.	.	.	.	.	.	.	.	1	1	.	1	X	0	.	.	.	2	.	.	2317,66	5
14	Kouogueu	2355	.	0	.	.	.	.	0	1	.	.	.	.	2	X	1	.	.	.	.	.	2312,75	4
15	Ba	2271	.	.	.	.	.	.	.	.	1	1	.	1	.	1	X	.	1	.	.	.	2312,73	5
16	Vd Akker	2324	.	.	.	0	.	.	.	.	.	.	1	1	.	.	.	X	.	.	2	1	2264,39	5
17	Samb	2341	.	.	0	.	.	.	.	.	.	.	.	.	.	.	1	.	X	1	1	2	2243,57	5
18	Scholma	2329	.	0	.	.	.	.	.	.	.	.	1	.	0	.	.	.	1	X	2	.	2243,00	4
19	Pierre	2203	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	0	1	0	X	2	2089,63	3
20	Tuvshinbold	2175	.	.	.	.	0	.	0	.	.	.	.	.	.	.	.	1	0	.	0	X	1967,14	1

Table A5.4

STPR Swiss pairing ‘Buchholz’

Pl	Name	Rating	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	St. PR	Pt
1	Schwarzman	2410	X	1	1	.	.	1	.	2	2	.	.	.	.	.	.	.	.	.	.	.	2564,56	7
2	Valneris	2386	1	X	.	1	.	1	2	.	.	.	.	.	.	.	.	2	.	.	.	.	2536,51	7
3	Georgiev	2438	1	.	X	1	.	.	.	.	1	.	.	.	.	2	.	2	.	.	.	.	2531,15	7
4	Podolskij	2438	.	1	1	X	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2473,77	6
5	Chizhov	2449	.	.	.	1	X	.	.	1	.	1	.	1	.	.	.	.	2	.	.	.	2424,68	6
6	Mikhalchenka	2344	1	1	.	1	.	X	0	.	.	.	.	.	.	.	.	.	2	.	.	.	2413,56	5
7	Ndjofang	2364	.	0	.	.	.	2	X	1	.	.	.	.	.	.	.	.	.	2	.	1	2381,23	6
8	Vd Akker	2324	0	.	.	.	1	.	1	X	.	.	1	.	.	.	.	2	.	.	.	.	2375,83	5
9	Anikeev	2328	0	.	1	.	.	.	.	.	X	.	.	.	1	.	1	.	.	.	2	.	2369,24	5
10	Scholma	2329	.	.	.	.	1	.	.	.	.	X	1	1	1	.	1	.	.	.	.	.	2350,74	5
11	Misans	2341	.	.	.	.	.	.	.	1	.	1	X	1	1	1	.	.	.	.	.	.	2349,78	5
12	Ba	2271	.	.	.	.	1	.	.	.	.	1	1	X	1	1	.	.	.	.	.	.	2346,73	5
13	Kouogueu	2355	.	.	.	.	.	.	.	.	1	1	1	1	X	.	1	.	.	.	.	.	2346,60	5
14	Samb	2341	.	.	0	.	.	.	.	.	.	.	1	1	.	X	1	.	.	2	.	.	2337,88	5
15	Amrillaew	2305	.	.	.	.	.	.	.	.	1	1	.	.	1	1	X	.	.	.	1	.	2308,93	4
16	Pierre	2203	.	0	0	.	.	.	.	0	.	.	.	.	.	.	.	X	.	.	2	2	2216,91	4
17	Lagoda	2301	.	.	.	.	0	0	.	.	.	.	.	.	.	.	.	.	X	1	1	2	2163,63	4
18	Domchev	2316	.	.	.	.	.	.	0	.	.	.	.	.	.	0	.	.	1	X	1	2	2151,57	4
19	Thijssen	2362	.	.	.	.	.	.	.	.	0	.	.	.	.	.	1	0	1	1	X	.	2134,01	3
20	Tuvshinbold	2175	.	.	.	0	.	.	1	.	.	.	.	.	.	.	.	0	0	0	.	X	1961,29	1

Table A5.5

Pairing of Swiss on Buchholz and Solkoff

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
1	20	17	11	10	14	9	19	2	18	15	16	5	6	3	13	8	7	4	12
2	19	18	4	15	13	5	8	1	14	9	20	6	17	12	7	3	11	10	16
3	18	19	7	14	8	15	12	5	6	4	11	13	9	1	10	2	16	17	20
4	17	20	2	12	11	7	16	13	5	3	8	18	14	15	6	9	10	1	19
5	16	14	10	8	9	2	15	3	4	7	19	1	12	20	17	11	6	13	18
6	15	13	8	11	17	16	18	19	3	10	9	2	1	7	4	12	5	20	14
7	14	16	3	20	12	4	13	11	8	5	17	9	18	6	2	19	1	15	10
8	13	15	6	5	3	18	2	14	7	16	4	12	11	10	19	1	20	9	17
9	12	11	20	16	5	1	14	15	10	2	6	7	3	19	18	4	17	8	13
10	11	12	5	1	19	14	17	20	9	6	18	16	15	8	3	13	4	2	7
11	10	9	1	6	4	19	20	7	12	13	3	14	8	17	16	5	2	18	15
12	9	10	16	4	7	20	3	18	11	17	13	8	5	2	14	6	15	19	1
13	8	6	15	18	2	17	7	4	16	11	12	3	20	14	1	10	19	5	9
14	7	5	19	3	1	10	9	8	2	20	15	11	4	13	12	17	18	16	6
15	6	8	13	2	18	3	5	9	17	1	14	19	10	4	20	16	12	7	11
16	5	7	12	9	20	6	4	17	13	8	1	10	19	18	11	15	3	14	2
17	4	1	18	19	6	13	10	16	15	12	7	20	2	11	5	14	9	3	8
18	3	2	17	13	15	8	6	12	1	19	10	4	7	16	9	20	14	11	5
19	2	3	14	17	10	11	1	6	20	18	5	15	16	9	8	7	13	12	4
20	1	4	9	7	16	12	11	10	19	14	2	17	13	5	15	18	8	6	3

Table A5.6

Pairing of Swiss on Rating and Swiss on STPR with pairing on rating

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	19	18	13	9	3	4	16	11	10	8	17	15	14	5	20	6	2
2	11	9	19	18	4	16	7	17	8	12	20	6	3	13	10	14	1
3	12	4	9	15	1	19	8	20	11	7	10	17	2	6	13	16	18
4	13	3	6	14	2	1	5	15	20	11	8	12	7	18	16	9	19
5	9	11	10	19	18	6	4	8	12	17	15	14	16	1	7	20	13
6	10	7	4	20	8	5	11	12	9	16	14	2	19	3	17	1	15
7	14	6	20	11	12	8	2	13	18	3	16	9	4	15	5	10	17
8	16	20	11	12	6	7	3	5	2	1	4	13	18	14	15	17	9
9	5	2	3	1	15	14	13	18	6	20	12	7	10	17	19	4	8
10	6	14	5	17	16	13	15	19	1	18	3	20	9	11	2	7	12
11	2	5	8	7	20	12	6	1	3	4	13	19	17	10	18	15	14
12	3	13	18	8	7	11	20	6	5	2	9	4	15	16	14	19	10
13	4	12	1	16	17	10	9	7	14	19	11	8	20	2	3	18	5
14	7	10	17	4	19	9	18	16	13	15	6	5	1	8	12	2	11
15	18	19	16	3	9	20	10	4	17	14	5	1	12	7	8	11	6
16	8	17	15	13	10	2	1	14	19	6	7	18	5	12	4	3	20
17	20	16	14	10	13	18	19	2	15	5	1	3	11	9	6	8	7
18	15	1	12	2	5	17	14	9	7	10	19	16	8	4	11	13	3
19	1	15	2	5	14	3	17	10	16	13	18	11	6	20	9	12	4
20	17	8	7	6	11	15	12	3	4	9	2	10	13	19	1	5	16

Table A 5.7

Pairing of Swiss on STPR like Buchholz

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
1	20	5	10	8	19	17	18	6	16	13	4	15	14	2	9	3	11
2	19	18	16	13	3	6	12	17	9	4	7	8	11	1	10	14	20
3	18	19	4	7	2	13	6	9	14	20	8	11	12	17	16	1	15
4	17	16	3	12	7	9	8	18	11	2	1	20	13	6	14	5	19
5	16	1	11	19	10	20	17	13	15	6	14	9	8	18	7	4	12
6	15	13	18	16	14	2	3	1	10	5	20	19	17	4	12	7	8
7	14	20	9	3	4	8	11	15	19	12	2	18	16	13	5	6	10
8	13	15	14	1	12	7	4	11	18	9	3	2	5	20	19	10	6
9	12	11	7	20	17	4	14	3	2	8	16	5	19	10	1	15	18
10	11	12	1	17	5	19	15	20	6	16	13	14	18	9	2	8	7
11	10	9	5	14	20	12	7	8	4	17	19	3	2	16	15	13	1
12	9	10	20	4	8	11	2	14	13	7	18	16	3	15	6	17	5
13	8	6	15	2	18	3	16	5	12	1	10	17	4	7	20	11	14
14	7	17	8	11	6	15	9	12	3	18	5	10	1	19	4	2	13
15	6	8	13	18	16	14	10	7	5	19	17	1	20	12	11	9	3
16	5	4	2	6	15	18	13	19	1	10	9	12	7	11	3	20	17
17	4	14	19	10	9	1	5	2	20	11	15	13	6	3	18	12	16
18	3	2	6	15	13	16	1	4	8	14	12	7	10	5	17	19	9
19	2	3	17	5	1	10	20	16	7	15	11	6	9	14	8	18	4
20	1	7	12	9	11	5	19	10	17	3	6	4	15	8	13	16	2

Table A5.8

Appendix 6

Ranking table WC 2007 Pairings Swiss system

Name	System	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6	Round 7	Round 8	Round 9	Round 10
Lagoda	RR	6-15	6-13	13-15	12-14	10	11	6	11	15	16
	SOLKOFF	17-20	14-20	19-20	18	19	17	18	18	19	19
	B/SB	17-20	15-20	20	18	18-19	18	18	18	19	19
	RATING	9	16	10	9	11	10	5	9	9	10
	STPR	19	17	16	17	17	18	19	18	17	16
	STPR R	15	16	14	14	13	12	10	11	11	12
Amrilaew	RR	6-15	6-13	9-12	9-11	11-13	6	7-8	8	8-9	10-11
	SOLKOFF	5-16	9-13	8	7	7	8-9	9	12	12	11
	B/SB	5-16	13	8-12	12	7	9-11	9	9-11	11	9
	RATING	8	9	8	8	7	9	9	7	6	5
	STPR	12	13	14	14	15	14	12	10	9	8
	STPR R	14	10	9	9	8	10	11	9	8	7
Anikeev	RR	6-15	6-13	8	8	9	5	13	12	12	12
	SOLKOFF	5-16	7	7	13-14	13-15	13-14	11	10	7	6
	B/SB	5-16	7	7	13	12-13	13	14	12	7	6
	RATING	5-6	8	7	7	8	4	4	4	4	9
	STPR	11	6	6	7	9	9	6	5	6	7
	STPR R	8	8	7	8	9	7	7	7	7	9
Georgiev	RR	6-15	14-16	13-15	12-14	14	14	9-10	5	5	5
	SOLKOFF	1-4	1-6	6	5	3	2-3	1	1	1	1
	B/SB	1-4	1-6	4	3	3	3	1	1	1	1
	RATING	11	11	12	11	12	12	13	15	12	8
	STPR	2	1	1	3	3	2	1	1	1	1
	STPR R	5	9	11	11	11	9	9	10	10	8
Domchev	RR	6-15	6-13	9-12	5-6	5-6	7	9-10	9	10	10-11
	SOLKOFF	17-20	14-20	14	13-14	13-15	13-14	15	13-14	11	9
	B/SB	17-20	15-20	14	15	15	14	16	15	12	11
	RATING	7	15	14	13	6	7	8	6	10	11
	STPR	18	18	19	19	18	17	18	19	18	18
	STPR R	12	15	13	15	7	8	8	8	9	11
Misans	RR	6-15	14-16	13-15	12-14	5-6	10	14	14	13	13
	SOLKOFF	5-16	9-13	9-13	8-12	8-12	8-9	8	9	14	12
	B/SB	5-16	9-12	8-12	7-11	14	8	8	9-11	14	12
	RATING	4	6	5	6	4	5	6	5	5	6
	STPR	13	11	11	12	11	11	13	14	12	13
	STPR R	4	5	6	6	5	6	5	5	6	6
Schwarzman	RR	1-4	2	3-4	7	7	8-9	4-5	2-3	4	1-2
	SOLKOFF	1-4	1-6	1	1-2	1-2	1	2	2	3	5
	B/SB	1-4	1-6	1	2	2	1	2	2	3	5
	RATING	2	2	6	5	5	8	10	10	7	4
	STPR	1	2	2	1	1	4	3	3	3	3
	STPR R	2	3	4	3	4	4	6	6	4	4

Table A6 Pairing Swiss system

Name	System	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6	Round 7	Round 8	Round 9	Round 10
Chizhov	RR	1-4	1	1-2	1	1	1-2	1-2	4	1	1-2
	SOLKOFF	5-16	9-13	9-13	8-12	8-12	10-12	12-14	13-14	6	4
	B/SB	5-16	9-12	8-12	7-11	8-11	9-11	10-13	13	6	4
	RATING	1	1	4	2	3	2	3	3	3	2
	STPR	6	7	7	6	5	3	4	4	5	2
	STPR R	1	1	2	2	3	1	1	2	3	1
Valneris	RR	17-20	17	16	16	17	17	17	16	16	15
	SOLKOFF	5-16	1-6	3-5	6	6	7	10	8	13	15
	B/SB	5-16	1-6	3	6	6	7	10-13	8	13	15
	RATING	13	12	13	14	14	14	14	14	11	14
	STPR	7	4	3	2	2	1	2	2	2	6
	STPR R	9	12	10	10	10	11	12	12	12	10
Otgonbayar	RR	17-20	20	20	20	20	20	20	20	20	20
	SOLKOFF	5-16	14-20	19-20	20	20	20	20	20	20	20
	B/SB	5-16	15-20	19	20	20	20	20	20	20	20
	RATING	20	18	20	20	20	20	20	20	20	20
	STPR	16	19	20	20	20	20	20	20	20	20
	STPR R	20	20	19	20	20	20	20	20	20	20
Ndjofang	RR	6-15	6-13	17	17	18	8-9	4-5	7	11	6
	SOLKOFF	5-16	14-20	15	16	16-17	15	6	6	8	13
	B/SB	5-16	15-20	15	16	17	15	6	6	8	13
	RATING	14	5	2	3	2	1	1	1	2	3
	STPR	14	16	15	15	7	7	8	11	10	10
	STPR R	10	6	3	4	1	2	2	1	1	3
Podolski	RR	5	5	3-4	2	2	3	3	1	2	3
	SOLKOFF	5-16	1-6	3-5	3-4	4-5	4-5	3-4	3	2	2
	B/SB	5-16	1-6	5-6	5	5	5	5	3	2	2
	RATING	12	3	1	1	1	3	2	2	1	1
	STPR	5	3	5	5	4	5	5	6	4	4
	STPR R	6	2	1	1	2	3	3	3	2	2
Scholma	RR	17-20	18-19	6-7	15	15-16	15-16	11-12	6	3	4
	SOLKOFF	5-16	9-13	9-13	8-12	8-12	6	5	5	5	3
	B/SB	5-16	9-12	8-12	7-11	8-11	6	4	5	5	3
	RATING	5-6	14	18	19	17	13	12	12	14	12
	STPR	8	10	10	10	10	10	10	9	11	11
	STPR R	7	14	18	18	18	15	14	14	15	14
Akker	RR	1-4	3-4	1-2	3	3	1-2	1-2	2-3	6	7
	SOLKOFF	17-20	14-20	16	17	16-17	18	17	17	17	17
	B/SB	17-20	15-20	16	17	16	17	17	17	17	17
	RATING	18	20	16	15	13	11	16	18	15	13
	STPR	17	14	8	8	8	6	7	7	7	9
	STPR R	18	18	16	16	16	18	18	18	18	16

Table A6 Pairing Swiss system

Name	System	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6	Round 7	Round 8	Round 9	Round 10
Ba	RR	16	14-16	18	19	19	19	18	18	19	19
	SOLKOFF	5-16	9-13	9-13	8-12	8-12	10-12	12-14	11	15	10
	B/SB	5-16	9-12	8-12	7-11	8-11	9-11	10-13	9-11	15	10
	RATING	10	10	9	10	9	16	11	11	17	18
	STPR	15	12	12	11	12	15	14	13	13	12
	STPR R	16	11	15	13	15	16	15	15	16	18
Samb	RR	6-15	6-13	9-12	9-11	11-13	12-13	15	15	8-9	9
	SOLKOFF	1-4	1-6	2	1-2	1-2	2-3	3-4	4	4	7
	B/SB	1-4	1-6	2	1	1	2	3	4	4	7
	RATING	17	19	17	17	16	15	18	16	13	16
	STPR	3	8	13	13	14	13	11	12	14	14
	STPR R	17	17	17	17	17	17	16	16	14	15
Pierre	RR	17-20	18-19	19	18	15-16	18	19	19	17	18
	SOLKOFF	17-20	14-20	17	15	13-15	16	16	15	9	14
	B/SB	17-20	15-20	18	14	12-13	16	15	14	9	14
	RATING	19	17	19	18	19	19	17	19	18	17
	STPR	20	20	17	16	16	16	17	17	19	19
	STPR R	19	19	20	19	19	19	19	19	19	17
Kouogueu	RR	6-15	6-13	9-12	9-11	11-13	12-13	7-8	13	7	8
	SOLKOFF	5-16	8	9-13	8-12	8-12	10-12	12-14	16	10	8
	B/SB	5-16	8	13	7-11	8-11	12	10-13	16	10	8
	RATING	16	7	11	12	18	18	15	13	16	15
	STPR	9	9	9	9	13	12	9	8	8	5
	STPR R	13	7	8	7	14	14	13	13	13	13
Thijssen	RR	6-15	6-13	5	5-6	8	15-16	16	17	18	17
	SOLKOFF	5-16	14-20	18	19	18	19	19	19	18	18
	B/SB	5-16	14	17	19	18-19	19	19	19	18	18
	RATING	15	13	15	16	15	17	19	17	19	19
	STPR	10	15	18	18	19	19	16	15	16	17
	STPR R	11	13	12	12	12	13	17	17	17	19
Mikhalchenka	RR	1-4	3-4	6-7	4	4	4	11-12	10	14	14
	SOLKOFF	1-4	1-6	3-5	3-4	4-5	4-5	7	7	16	16
	B/SB	1-4	1-6	5-6	4	4	4	7	7	16	16
	RATING	3	4	3	4	10	6	7	8	8	7
	STPR	4	5	4	4	6	8	15	16	15	15
	STPR R	3	4	5	5	6	5	4	4	5	5

Table A6 Pairing Swiss system

Name	System	Round 11	Round 12	Round 13	Round 14	Round 15	Round 16	Round 17	Round 18	Round 19	Final*
Lagoda	RR	18	19	19	19	18	18	19	18	18	18
	SOLKOFF	19	19	18	18	18	18	17-18	17-18	18	
	B/SB	19	19	18	18	18	18	18	18	18	
	RATING	12	16	16	17	17	17	17			
	STPR	15	16	15	16	16	15	18	18	18	
	STPR R	13	16	16	16	17	18	18			
Amrilaew	RR	9	10	10	10	9	8	9	8	7	7
	SOLKOFF	10	11	7	7	6-7	8	7	8	7	
	B/SB	8	8	7	7	5	6	7	8	7	
	RATING	5	6	7	8	4	5	7			
	STPR	7	6	6	6	6	7	6	7	7	
	STPR R	7	6	7	8	5	6	7			
Anikeev	RR	11	9	9	7	6	6	8	7	6	5-6
	SOLKOFF	4	5-6	6	6	6-7	7	5	5-6	5-6	
	B/SB	4	5	6	6	7	7	5	5	5	
	RATING	10	9	9	6	7	4	5			
	STPR	6	5	5	5	4	4	4	5	6	
	STPR R	11	9	9	7	7	4	5			
Georgiev	RR	5	5	5	8	8	7	5	4	3	3
	SOLKOFF	1	1	2	2	2	2	1-2	2-3	3	
	B/SB	1	1	2	2	2	2	2	2	3	
	RATING	4	5	6	4	2	2	3			
	STPR	1	1	1	1	1	1	2	3	3	
	STPR R	4	5	4	4	2	2	3			
Domchev	RR	13	13	14	14	15	17	17	17	16	16
	SOLKOFF	9	12	15	15	15	16	16	16	16	
	B/SB	10	12	15	15	15	16	16	16	16	
	RATING	11	11	15	15	16	15	16			
	STPR	19	18	18	17	17	16	17	16	16	
	STPR R	12	12	15	15	15	16	16			
Misans	RR	12	12	13	13	13	14	13	14	14	9-14
	SOLKOFF	11	14	13	14	14	10	12	10-11	9-14	
	B/SB	11	15	13	14	14	11	12	11	12	
	RATING	7	7	8	11	11	11	12			
	STPR	14	14	14	14	14	13	13	11	12-13	
	STPR R	8	7	8	11	12	12	13			
Schwarzman	RR	1	1	1	1	1	1-2	1	1	1	1-2
	SOLKOFF	3	3	3	3	3	3	3	1	1-2	
	B/SB	3	3	3	3	3	3	1	1	2	
	RATING	3	3	2	2	3	3	2			
	STPR	4	2	2	2	2	3	3	2	2	
	STPR R	3	3	2	2	3	3	2			

Table A6 Pairing Swiss system

Name	System	Round 11	Round 12	Round 13	Round 14	Round 15	Round 16	Round 17	Round 18	Round 19	Final*
Chizhov	RR	3	3	3	3	3	1-2	3	3	4	4
	SOLKOFF	6	4	5	4	4	4	4	4	4	
	B/SB	6	4	5	4	4	4	4	4	4	
	RATING	2	4	3	3	5	7	6			
	STPR	3	4	4	4	5	5	5	4	4	
	STPR R	2	2	3	3	4	5	4			
Valneris	RR	15	15	16	15	16	13	15	13	9	9-14
	SOLKOFF	13	13	11	12	13	11	11	13-14	9-14	
	B/SB	12	13	11	12	12	10	11	13-14	9	
	RATING	13	12	13	10	10	10	13			
	STPR	8	8	9	12	9	11	10	12	9	
	STPR R	10	11	12	9	10	9	10			
Otgonbayar	RR	20	20	20	20	20	20	20	20	20	20
	SOLKOFF	20	20	20	20	20	20	20	20	20	
	B/SB	20	20	20	20	20	20	20	20	20	
	RATING	20	20	20	20	20	20	20			
	STPR	20	20	20	20	20	20	20	20	20	
	STPR R	20	20	20	20	20	20	20			
Ndjofang	RR	7	8	8	5	4	5	10	10	9	9-14
	SOLKOFF	8	8	8	10	9	9	10	9	9-14	
	B/SB	9	9	8	10	9	9	10	9	13	
	RATING	6	2	4	7	8	9	9			
	STPR	9	9	8	7	8	8	8	10	10	
	STPR R	5	4	5	5	8	8	8			
Podolski	RR	2	2	2	2	2	3	2	2	2	1-2
	SOLKOFF	2	2	1	1	1	1	1-2	2-3	1-2	
	B/SB	2	2	1	1	1	1	3	3	1	
	RATING	1	1	1	1	1	1	1			
	STPR	2	3	3	3	3	2	1	1	1	
	STPR R	1	1	1	1	1	1	1			
Scholma	RR	4	4	4	6	5	4	4	5	5	5-6
	SOLKOFF	5	5-6	4	5	8	6	6	5-6	5-6	
	B/SB	5	6	4	5	8	8	6	6	6	
	RATING	9	8	5	5	6	6	4			
	STPR	12	11	11	8	7	6	7	6	5	
	STPR R	9	10	6	6	6	7	6			
Akker	RR	8	7	7	9	10	9	11	12	12	9-14
	SOLKOFF	12	15	12	8	5	5	8	10-11	9-14	
	B/SB	13	14	12	8	6	5	8	10	10-11	
	RATING	14	13	14	13	12	12	10			
	STPR	10	12	13	13	13	14	9	9	14	
	STPR R	16	14	14	13	14	13	12			

Table A6 Pairing Swiss system

Name	System	Round 11	Round 12	Round 13	Round 14	Round 15	Round 16	Round 17	Round 18	Round 19	Final*
Ba	RR	19	17	17	17	14	15	14	15	15	15
	SOLKOFF	17	16	14	13	16	15	15	15	15	
	B/SB	15	16	14	13	16	15	15	15	15	
	RATING	18	17	17	16	15	14	14			
	STPR	16	15	16	15	15	17	15	15	15	
	STPR R	18	17	17	17	16	15	15			
Samb	RR	6	6	6	4	7	10-11	6-7	9	10	9-14
	SOLKOFF	14	9	10	11	11	13	14	12	9-14	
	B/SB	14	10	10	11	11	14	14	12	14	
	RATING	16	15	10	9	14	16	15			
	STPR	11	10	10	9	10	9	14	14	12-13	
	STPR R	14	13	11	10	13	14	14			
Pierre	RR	17	18	18	18	19	19	18	19	19	19
	SOLKOFF	15	18	19	19	19	19	19	19	19	
	B/SB	16	18	19	19	19	19	19	19	19	
	RATING	17	18	18	19	19	19	19			
	STPR	18	19	19	19	19	19	19	19	19	
	STPR R	17	18	18	19	19	19	19			
Kouogueu	RR	10	11	12	12	12	10	6-7	6	8	8
	SOLKOFF	7	7	9	9	10	12	9	7	8	
	B/SB	7	7	9	9	10	12	9	7	8	
	RATING	15	14	12	12	9	8	8			
	STPR	5	7	7	11	11	10	11	8	8	
	STPR R	15	15	13	12	9	10	9			
Thijssen	RR	16	16	15	16	17	16	16	16	17	17
	SOLKOFF	18	17	17	17	17	17	17-18	17-18	17	
	B/SB	18	17	17	17	17	17	17	17	17	
	RATING	19	19	19	18	18	18	18			
	STPR	17	17	17	18	18	18	16	17	17	
	STPR R	19	19	19	18	18	17	17			
Mikhalchenka	RR	14	14	11	11	11	12	12	11	11	9-14
	SOLKOFF	16	10	16	16	12	14	13	13-14	9-14	
	B/SB	17	11	16	16	13	13	13	13-14	10-11	
	RATING	8	10	11	14	13	13	11			
	STPR	13	13	12	10	12	12	12	13	11	
	STPR R	6	8	10	14	11	11	11			

Table A6 Pairing Swiss system

Appendix 7

Statistics Dutch Opens 2004-2008

Open Dutch Championships

Open Swiss Tournament	**The Hague 2008**
Number of participants	101
Without Rating	11
With Rating	90
Minimum Rating	482
Maximum Rating	1557
Mean	1092
Median	1092
Standard Deviation	230

Table A7.1 Source: Tournament Base

Open Swiss Tournament	**Nijmegen 2007**
Number of participants	130
Without Rating	7
With Rating	123
Minimum Rating	600
Maximum Rating	1542
Mean	1122
Median	1102
Standard Deviation	197

Table A7.2 Source: Tournament Base

Open Swiss Tournament	**The Hague 2006**
Number of participants	130
Without Rating	14
With Rating	116
Minimum Rating	496
Maximum Rating	1571
Mean	1133
Median	1137
Standard Deviation	219

Table A7.3 Source: Tournament Base

Open Swiss Tournament	Nijmegen 2005
Number of participants	119
Without Rating	16
With Rating	135
Minimum Rating	686
Maximum Rating	1565
Mean	1169
Median	1180
Standard Deviation	192

Table A7.4 Source: Tournament Base

Open Swiss Tournament	The Hague 2004
Number of participants	119
Without Rating	23
With Rating	96
Minimum Rating	531
Maximum Rating	1588
Mean	1130
Median	1143
Standard Deviation	204

Table A7.5 Source: Tournament Base

Tournament Statistics	2004-2008 Together
Total Number of participants	626
Without Rating	71
With Rating	555
Maximum Rating	482
Maximum	1588
Mean	1124
Median	1128
Standard Deviation	217

Table A7.6 Source: Tournament Base

Appendix 8

Wilcoxon Signed Ranks Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
Rating - Solkoff	Negative Ranks	76[a]	56,80	4316,50
	Positive Ranks	24[b]	30,56	733,50
	Ties	0[c]		
	Total	100		

a. Rating < Solkoff

b. Rating > Solkoff

c. Rating = Solkoff

Test Statistics[b]

	Rating - Solkoff
Z	-6,160[a]
Asymp. Sig. (2-tailed)	,000

a. Based on positive ranks.

b. Wilcoxon Signed Ranks Test

Figure A8.1

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
STPRR - Rating	Negative Ranks	99[a]	50,90	5039,00
	Positive Ranks	1[b]	11,00	11,00
	Ties	0[c]		
	Total	100		

a. STPRR < Rating

b. STPRR > Rating

c. STPRR = Rating

Test Statistics[b]

	STPRR - Rating
Z	-8,644[a]
Asymp. Sig. (2-tailed)	,000

a. Based on positive ranks.

b. Wilcoxon Signed Ranks Test

Figure A8.2

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
STPRR - STPR	Negative Ranks	75[a]	55,12	4134,00
	Positive Ranks	25[b]	36,64	916,00
	Ties	0[c]		
	Total	100		

a. STPRR < STPR

b. STPRR > STPR

c. STPRR = STPR

Test Statistics[b]

	STPRR - STPR
Z	-5,532[a]
Asymp. Sig. (2-tailed)	,000

a. Based on positive ranks.

b. Wilcoxon Signed Ranks Test

Figure A8.3