

Optimal Solutions to Tennis Scoring Systems, Challenge System, Court Surface Allocation and Olympic Games Format

By
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Scoring Systems

The fundamental problem with current scoring systems is the deuce game is very "inefficient". Some games can last for 25 minutes. The 50-40 game where the server has to win 4 points and the receiver has to win 3 points is very "efficient". At most only 6 points are played in such a game. The number of games played in a set are significantly reduced since there are more breaks of serve. Hence, with the 50-40 game, a 'long' advantage final set is highly unlikely. The author has listed all the current scoring systems in table 1 and proposed scoring systems in the second table 2. The author thinks it makes sense to have just the one game structure and the 50-40 game due to its simplicity I feel is best to achieve this goal. All the early sets are tiebreak with a first-to-7 point tiebreak game at 6 games-all. The final set is advantage with a first-to-7 point tiebreak game at 12 games-all. Playing a final advantage set makes sense to keep with tradition. Matches are either 3 or 5 sets. This simplifies the scoring systems to 2. The author published a paper:

Barnett T (2012). Analyzing tennis scoring systems: from the origins to today. *Journal of Medicine and Science in Tennis* 17(2), 68-77.

<http://strategicgames.com.au/article32.pdf>

which demonstrates why the deuce game came about and why the 50-40 game could potentially replace it. The idea of "deuce" was introduced (at least as far as 1490) with a simple explanation - to ensure that the game could not be won by a one-point difference in players' scores. Hence deuce was derived from the French "a deux du jeu" - two points away from game.

System	Event	Games	Early Sets	Final Set	Match
1	US Open women's singles Aust./French/US Open women's doubles Aust./French/US Open men's doubles Olympics men's and women's singles Olympics men's and women's doubles Men's and women's singles	Deuce	Tiebreak First-to-7 points tiebreak game	Tiebreak First-to-7 points tiebreak game	3 sets
2	Australian Open women's singles	Deuce	Tiebreak First-to-7 points tiebreak game	Tiebreak First-to 10 points tiebreak game	3 sets
3	French women's singles	Deuce	Tiebreak First-to-7 points tiebreak game	Advantage	3 sets
4	Aust/French/US Open mixed doubles Olympics mixed doubles	Deuce	Tiebreak First-to-7 points tiebreak game	First-to-10 points tiebreak game	3 sets
5	Men's and women's doubles	No-ad	Tiebreak First-to-7 points tiebreak game	First-to-10 points tiebreak game	3 sets
6	US Open men's singles	Deuce	Tiebreak First-to-7 points tiebreak game	Tiebreak First-to-7 points tiebreak game	5 sets
7	Australian Open men's singles	Deuce	Tiebreak First-to-7 points tiebreak game	Tiebreak First-to 10 points tiebreak game	5 sets
8	French Olympics men's singles (Gold medal)	Deuce	Tiebreak First-to-7 points tiebreak game	Advantage	5 sets
9	Wimbledon women's singles Wimbledon women's doubles Wimbledon mixed doubles	Deuce	Tiebreak First-to-7 points tiebreak game	Tiebreak First-to-7 points tiebreak game at 12 games-all	3 sets
10	Wimbledon men's singles Wimbledon men's doubles	Deuce	Tiebreak First-to-7 points tiebreak game	Tiebreak First-to-7 points tiebreak game at 12 games-all	5 sets

Table 1: Current scoring systems used in men's and women's singles, doubles and mixed doubles

System	Event	Games	Early Sets	Final Set	Match
2	Grand Slam women's singles Grand Slam women's doubles Grand Slam men's doubles Olympics men's singles Olympics women's singles Olympics men's doubles Olympics women's doubles Men's singles Women's singles Grand Slam mixed doubles Olympics mixed doubles Men's doubles Women's doubles	50-40	Tiebreak First-to-7 points tiebreak game	Advantage First-to-7 points tiebreak game at 12 games-all	3 sets
3	Grand Slam men's singles Olympics men's singles (Gold medal)	50-40	Tiebreak First-to-7 points tiebreak game	Advantage First-to-7 points tiebreak game at 12 games-all	5 sets

Table 2: Proposed scoring systems used in men's and women's singles, doubles and mixed doubles

	Deuce game	No-Ad game	50-40 game
10-10	79.5%	69.0%	29.7%
20-20	63.0%	47.3%	8.0%
30-30	49.9%	32.4%	2.2%
40-40	39.6%	22.2%	0.6%
50-50	31.4%	15.2%	0.2%
60-60	24.9%	10.4%	0.0%
70-70	19.7%	7.1%	0.0%

Table 3: Chances of reaching x-games all in an advantage set across three different game structures and the probabilities of both players winning a point on serve is 83%.

Table 3 gives the chances of reaching x-games all in an advantage set across three different game structures and the probabilities of both players winning a point on serve is 83% to reflect the 11 hour Isner vs Mahut match. Note the chances of reaching 70-all for the deuce game of 19.7% and the No-Ad game of 7.1%. Whereas for the 50-40 game players won't get anywhere near 70-all (assuming no tiebreak game is played at 12 games-all). In the 11 hour Isner Mahut match both players were winning 77.2% and 81.9% of points on serve in the final set. Note that in the final set of the Isner vs Mahut match, there was 2.9% chance of reaching 69 games-all in the advantage final set. Refer to section 8.4 in <http://strategicgames.com.au/book.pdf> for a full analysis of the Isner vs Mahut match. Also, it could be argued that playing a 11 hour match could have health affects on the players.

	Deuce game	No-Ad game	50-40 game
0.5	95.7%	93.1%	95.5%
1	26.3%	11.0%	9.2%
1.5	0.1%	0.0%	0.0%
2	0.0%	0.0%	0.0%

Table 4: Chances of reaching x-hours in a tiebreak set across three different game structures, the probabilities of both players winning a point on serve is 50% and the average time for a point played is 12 seconds.

Table 4 gives the chances of reaching x-hours in a tiebreak set across three different game structures, the probabilities of both players winning a point on serve is 50% and the average time for a point played is 12 seconds. On clay players can average only 50% of points won on serve. Also, players on clay average about 12 seconds to play a point. Note that using the deuce game there is a 26.3% chance of a tiebreak set reaching 1 hour and 0.1% chance of a tiebreak set reaching 1.5 hours. There are actual tiebreak sets under the deuce game that have gone for 1.5 hours. Using the 50-40 game the chances of reaching 1 hour are significantly reduced to only 9.2%.

	Deuce game	No-Ad game	50-40 game
55%, 50%	80.0%	77.2%	75.4%
65%, 60%	78.9%	76.9%	76.4%
75%, 70%	77.2%	76.7%	77.5%
85%, 80%	78.0%	78.4%	79.7%

Table 5: Chances of winning a best-of-5 set match with a first-to-7 point tiebreak game played at 6 games-all in early sets and an advantage set played in the final set played across three different game structures for different probabilities of players winning a point on serve.

Table 5 gives the chances of winning a best-of-5 set match with a first-to-7 point tiebreak game played at 6 games-all in early sets and an advantage set played in the final set played across three different game structures for different probabilities of players winning a point on serve. Note that this scoring structure typically applies to Wimbledon men's singles where player's on serve are often around the 70-75% range. Note that under the deuce game there is 77.2% chance of the better player winning, under the No-Ad game this is reduced to 76.7% but for the 50-40 game this percentage is increased to 77.5%.

	First-to-7 point tiebreak game	First-to-10 point tiebreak game	Advantage rule at 6 games-all using 50-40 games
55%, 50%	57.9%	59.2%	60.1%
65%, 60%	58.2%	59.5%	60.6%
75%, 70%	59.0%	60.5%	62.7%
85%, 80%	61.1%	62.7%	68.8%

Table 6: Chances of the better player winning at 6 games-all across three different scoring structures.

Table 6 gives the chances of the better player winning at 6-games-all across three different scoring structures. Note that playing a first-to-10 point tiebreak game increases the chances of the better player winning from a first-to-7 point tiebreak game by about 1.5%. Also note that playing an advantage rule at 6-games all using 50-40 games increases the chances of the better player winning when compared to a first-to-10 point tiebreak game. In particular the increase for the better player with players winning 85% and 80% on serve is 6.1%.

Therefore, the statistics indicate that the two proposed scoring systems can be suitably applied to all men's and women's singles, doubles and mixed doubles matches.

Challenge System

Challenging a line call takes time and for this reason players have unlimited opportunity to challenge, but once three incorrect challenges are made in a set, they cannot challenge again until the next set. If the set goes to a tiebreak game, players are given additional opportunities to challenge (usually one extra). If the match is tied at six games all in an advantage set, the counter is reset with both players again having a limit of up to three incorrect challenges in the next 12 games, and this resetting process is repeated after every 12 games. Under the current system players could run out of challenges and unable to challenge on a point with a sufficiently large amount of 'importance' which could make a big difference to the outcome of the match. For this reason, the following model is proposed.

Players are given x challenges per set and have unlimited opportunity to challenge, but once three incorrect challenges are made in a set, they cannot challenge again until the next set. Further, players can always challenge when the point has a sufficient level of 'importance' = y without affecting their challenge point total, otherwise players cannot challenge if they have run out of their challenge point total.

Scenario 1)

When $x=3$ and the level of 'importance'=1, is equivalent to the current system.

Scenario 2)

When $x=0$ and the level of 'importance'= y , is "optimally" the best system in terms of minimizing time on player's challenging on "unimportant" points.

Scenario 3)

When $1 \leq x \leq 3$ and the level of 'importance'= y , is somewhere between Scenario 1) and Scenario 2)

Refer to <http://strategicgames.com.au/article28.pdf> for the analysis for Scenario 3)

At the very least Scenario 3) should be adopted such that players can always challenge when the point has a sufficient level of 'importance' = y without affecting their challenge point total. However, Scenario 2) could be obtained as an "optimal" system in terms of minimizing time on player's challenging on "unimportant" points.

Court surface allocation

	Grass	Hard	Clay	
ATP	6 (4)	30 (21)	25 (18)	61 (43)
WTA	4 (3)	37 (26)	15 (11)	56 (40)

Table 1: Number of tournaments played on different surfaces for the 2006 ATP and WTA tour

	Grass	Hard	Clay	
ATP	8 (5)	38 (25)	21 (15)	67 (45)
WTA	6 (4)	36 (23)	16 (10)	58 (37)

Table 2: Number of tournaments played on different surfaces for the 2019 ATP and WTA tour

- Yearly rotation of surfaces between grass, hard and clay for the ATP and WTA finals
- Team structure played at the Olympic Games which could be considered a World Cup in tennis

	Grass	Hard	Clay	
ATP	0	6	3	9
WTA	0	7	2	9

Table 3: Number of tier 1 tournaments played on different surfaces for the 2019 ATP and WTA tour

- Insert three tier 1 tournaments played on each surface for tables 4 and 5

Tournament	Date	Current Surface	Recommended Surface
Brisbane International	1/01	Hard	Hard
Qatar ExxonMobil Open	1/01	Hard	Hard
Tata Open Maharashtra	1/01	Hard	Hard
ASB Classic	7/01	Hard	Hard
Sydney International	7/01	Hard	Hard
Australian Open	14/01	Hard	Hard
Cordoba Open	4/02	Clay	Grass
DIEMAXTRA Sofia Open	4/02	Hard	Grass
Open Sud de France	4/02	Hard	Grass
ABN AMRO World Tennis Tournament	11/02	Hard	Grass
Argentina Open	11/02	Clay	Grass
New York Open	11/02	Hard	Grass
Delray Beach Open	18/02	Hard	Grass
Open 13 Provence	18/02	Hard	Grass
Rio Open	18/02	Clay	Grass
Abierto Mexicano Telcel	25/02	Hard	Grass
Brasil Open	25/02	Clay	Grass
Dubai Duty Free Tennis Championship	25/02	Hard	Grass
BNP Paribas Open	4/03	Hard	Clay
Miami Open	18/03	Hard	Clay
Grand Prix Hassan II	8/04	Clay	Clay
US Men's Clay Court Championship	8/04	Clay	Clay
Monte-Carlo Rolex Masters	15/04	Clay	Clay
Barcelona Open Banc Sabadell	22/04	Clay	Clay
Gazprom Hungarian Open	22/04	Clay	Clay
BMW Open	29/04	Clay	Clay

Millennium Estoril Open	29/04	Clay	Clay
Mutua Madrid Open	6/05	Clay	Clay
Internazionali BNL d'Italia	13/05	Clay	Clay
Geneva Open	20/05	Clay	Clay
Open Parc	20/05	Clay	Clay
French Open	27/05	Clay	Clay
Libema Open	10/06	Grass	Grass
Mercedes Cup	10/06	Grass	Grass
Fever-Tree Championships	17/06	Grass	Grass
Noventi Open	17/06	Grass	Grass
Nature Valley International	24/06	Grass	Grass
Turkish Airlines Open Antalya	24/06	Grass	Grass
Wimbledon	1/07	Grass	Grass
Hall of Fame Open	15/07	Grass	Grass
Plava Laguna Croatia Open	15/07	Clay	Grass
SkiStar Swedish Open	15/07	Clay	Grass
BB&T Atlanta Open	22/07	Hard	Grass
German Tennis Championships	22/07	Clay	Grass
Swiss Open	22/07	Clay	Grass
Abierto Mexicano de Tenis Mifel	29/07	Hard	Grass
Citi Open	29/07	Hard	Grass
Generali Open	29/07	Clay	Grass
Coupe Rogers	5/08	Hard	Hard
Western & Southern Open	12/08	Hard	Hard
Winston-Salem Open	19/08	Hard	Hard
U.S. Open	26/08	Hard	Hard
Moselle Open	16/09	Hard	Hard
St. Petersburg Open	16/09	Hard	Hard
Chengdu Open	23/09	Hard	Hard
Zhuhai Open	23/09	Hard	Hard
China Open	30/09	Hard	Hard
Rakuten Japan Open	30/09	Hard	Hard
Shanghai Rolex Masters	7/10	Hard	Hard
European Open	14/10	Hard	Hard
Intrum Stockholm Open	14/10	Hard	Hard
Kremlin Cup	14/10	Hard	Hard
Erste Bank Open	21/10	Hard	Hard
Swiss Indoors Basel	21/10	Hard	Hard
BNP Paribas Masters	28/10	Hard	Hard
Next Gen ATP Finals	4/11	Hard	Hard
Nitto ATP Finals	11/11	Hard	Hard/Grass/Clay

Table 4: Tournaments played at the 2019 ATP tour

Tournament	Date	Current Surface	Recommended Surface
ASB Classic	1/01	Hard	Hard
Brisbane International	1/01	Hard	Hard
Shenzhen Open	1/01	Hard	Hard
Hobart International	7/01	Hard	Hard
Sydney International	7/01	Hard	Hard
Australian Open	14/01	Hard	Hard
St. Petersburg Ladies Trophy	28/01	Hard	Grass
Thailand Open	28/01	Hard	Grass
Qatar Total Open	11/02	Hard	Grass
Dubai Duty Free Championships	18/02	Hard	Grass
Hungarian Ladies Open	18/02	Hard	Grass
Abierto Mexicano TELCEL	25/02	Hard	Grass
BNP Paribas Open	4/03	Hard	Clay
Miami Open	18/03	Hard	Clay
Abierto GNP Seguros	1/04	Hard	Clay
Volvo Car Open	1/04	Clay	Clay
Claro Open Colsanitas	8/04	Clay	Clay
Samsung Open	8/04	Clay	Clay
Porsche Tennis Grand Prix	22/04	Clay	Clay
TEB BNP Paribas Istanbul Cup	22/04	Clay	Clay
Grand Prix De SAR La Princesse Lalla Meryem	29/04	Clay	Clay
J&T Banka Prague Open	29/04	Clay	Clay
Mutua Madrid Open	6/05	Clay	Clay
Internazionali BNL d'Italia	13/05	Clay	Clay
Internationaux de Strasbourg	20/05	Clay	Clay
Numberger Vericherungscup	20/05	Clay	Clay
French Open	27/05	Clay	Clay
Libema Open	10/06	Grass	Grass
Nature Valley Open	10/06	Grass	Grass
Mallorca Open	17/06	Grass	Grass
Nature Valley Classic	17/06	Grass	Grass
Nature Valley International	24/06	Grass	Grass
Wimbledon	1/07	Grass	Grass
Bucharest Open	15/07	Clay	Grass
Ladies Open Lausanne	15/07	Clay	Grass
Baltic Open	22/07	Clay	Grass
Palermo Ladies	22/07	Clay	Grass
Citi Open	29/07	Hard	Grass
Mubadala Silicon Valley Classic	29/07	Hard	Grass
Rogers Cup	5/08	Hard	Hard
Western & Southern Open	12/08	Hard	Hard
Bronx Open	19/08	Hard	Hard
U.S. Open	26/08	Hard	Hard
Japan Women's Open	9/09	Hard	Hard
Jiangxi Open	9/09	Hard	Hard
Zhengzhou Open	9/09	Hard	Hard
Guangzhou Open	16/09	Hard	Hard
Korea Open	16/09	Hard	Hard
Toray Pan Pacific Open	16/09	Hard	Hard

Wuhan Open	23/09	Hard	Hard
Tashkent Open	23/09	Hard	Hard
China Open	30/09	Hard	Hard
Tianjin Open	7/10	Hard	Hard
Upper Austria Ladies Linz	7/10	Hard	Hard
BGL Luxembourg Open	14/10	Hard	Hard
Kremlin Cup	14/10	Hard	Hard
WTA Elite Trophy	21/10	Hard	Hard
WTA Finals	28/20	Hard	Hard/Grass/Clay

Table 5: Tournaments played at the 2019 WTA tour

	Grass	Hard	Clay
ATP	4	22	14
WTA	3	20	9

Table 6: The number of tournaments a player can compete at for the different surfaces from the 2006 tournaments

	Grass	Hard	Clay
ATP	10	13	9
WTA	10	12	9

Table 7: The number of tournaments a player can compete at for the different surfaces from the 2019 tournaments

Olympic Games format

16 teams are divided into four groups of four teams. In the round robin stage, each group would be a round-robin of three rounds, where each round would consist of two men's singles matches, two women's singles matches, one men's doubles match, one women's doubles match and one mixed doubles match. The teams finishing first and second in each group would advance to an eight-team single-elimination bracket (quarter finals), then to a four-team single-elimination bracket (semi-finals) and then to a two-team single-elimination bracket (finals).

	Day 1	Matches
Group 1	Team 1 vs Team 2	7
Group 2	Team 1 vs Team 2	7
Group 3	Team 1 vs Team 2	7
Group 4	Team 1 vs Team 2	7
	Day 3	
Group 1	Team 1 vs Team 3	7
Group 2	Team 1 vs Team 3	7
Group 3	Team 1 vs Team 3	7
Group 4	Team 1 vs Team 3	7
	Day 5	
Group 1	Team 2 vs Team 3	7
Group 2	Team 2 vs Team 3	7
Group 3	Team 2 vs Team 3	7
Group 4	Team 2 vs Team 3	7
	Day 7	
QF1	1 st Group 1 vs 2 nd Group 2	7
QF2	2 nd Group 1 vs 1 st Group 2	7
QF3	1 st Group 3 vs 2 nd Group 4	7
QF4	2 nd Group 3 vs 1 st Group 4	7
	Day 9	
SF1	Winner QF1 vs Winner QF2	7
SF2	Winner QF3 vs Winner QF4	7
	Day 11	
F1	Winner SF1 vs Winner SF2	7
		126

Table: Schedule