**Creating More Accurate Rankings for ATP Players**

As a lifelong tennis fan since I stayed up all night to watch the epic 2017 Australian Open men’s final contested by Roger Federer and Rafael Nadal, two of the greatest tennis players of all time, I’ve spent a wholly unnecessary amount of time watching and thinking about tennis. I’ve watched tennis at 3PM and 3AM. I’ve watched one hour matches and five hour matches. I’ve watched tennis on TV, on my computer, and live here in Phoenix. I even forced my family to switch to Fubo TV because YouTube TV got rid of the Tennis Channel. There is just something that attracts me about the spectacle and nuance of the sport. It’s like boxing without the violence, chess with a single piece, a marathon with hundreds of finish lines. In my opinion, the greatest tennis matches I’ve ever witnessed, such as the aforementioned 2017 final, the 2018 Wimbledon semifinal between Nadal and Novak Djokovic (the GOAT), the 2019 Wimbledon final between Federer and Djokovic, are equal in magnitude and legacy to other great sporting events of this generation, whether it be the 2022 World Cup final, the 28-3 comeback in Super Bowl LI, or the Cavs’ comeback from 3-1 down in the 2016 NBA Finals. All in all, tennis is a vastly underrated sport, and it occupies a special place in my heart and a rent-free space in my mind. Thus, this project came to be.

One of the most unique aspects of tennis is the way in which it stacks up its players. Tennis does not really have a true season; it runs non-stop from the 1st day of the year (or last day of last year if you’re not in Australia) to late November, with only a month’s break at the end of the year. Not having a true season, it does not crown a single champion. The closest thing to the crowning of a champion is the winner of the ATP Finals, the last tournament held in the year between the best 8 performing players of the past year. However, this tournament differs from the final game of most sports competitions in the sense that it is not the tournament held in the highest regard by the tennis world; that honor goes to the 4 Grand Slams, and it can be argued even an Olympics gold is a higher achievement. Instead, eschewing the traditional idea of competing all year for a single trophy only to repeat the same thing in each following year, tennis prefers to use a rolling calendar to identify who the best players are at any given point in time during the year. Nobody really cares if you are leading the AFC South 5 games into the season, but being #1 at any point in time during the year is a very big deal in the tennis world due to this rolling system.

The actual methodology for ranking players is rather complicated, but there’s two important pieces which should be understood. Before going into detail on those two points, I’d like to explain the tennis calendar very briefly. In each week during the “season”, between one to sixish tournaments are played in various locations all over the world, lasting between one to two weeks. At each of these tournaments, only one player can be “champion” of the event, and everyone else loses a match (to get a sense for what this feels like mentally for most tennis players, imagine being the 2008 Lions, only for five seasons instead of one, and having to work up the motivation to continue practicing and showing up every week). Back to the important points, first, every player who enters an event has the opportunity to earn ATP points; the number of points a player earns is proportional to their performance in the event. So, for example, the winner of the event earns the most points, followed by the runner-up, followed by the losing semifinalists and so on. Then, the points from a specific number of tournaments (that’s the complicated part) from the past 52 weeks are added up to create the final number of ranking points for a player. These ranking points are sorted in descending order to create the ATP ranking system.

The rankings system is important for many reasons. For one, it’s an absolute methodology against which you can weigh your ability to the ability of your competitors. Everyone has seen those nonsensical Power Rankings that people try to use in other sports to rank teams based on some arbitrary criteria or another; the tennis system gives a definitive power ranking every single week. Second, the highest ranked players in a given tournament are seeded in the event; like the NCAA Tournament, being a seed means you don’t have the possibility of facing other seeds early on, increasing the probability you go deeper in the tournament. Additionally, higher ranked players open themselves up to guaranteed spots in important and financially lucrative tournaments, and generally tend to pull more viewers and fans, and therefore increase their attractiveness to potential sponsors.

Now that I’ve described the ranking system and its utility to the sport, I’d like to discuss a few drawbacks with the system that prompted me to undertake this project. There are three big issues that I see that I tried to address in my own personal rankings system. First of all, as previously mentioned, tennis ranks players using a rolling 52-week calendar; it sums all the points from relevant tournaments that you have accumulated in the past 52 weeks. You can argue this is a meritorious way to rank players; since the tennis calendar is mostly the same every year, every tournament can only be counted once for a ranking, and this system prohibits the best players from stacking up points over time and creating a gap that cannot be bridged. However, from the standpoint of “ranking the best tennis players”, I believe it has a flaw. Let’s say that we are in the start of August 2023 as I’m writing this. Player A and Player B both have 1000 points as of this week. However, Player A won 500 points in 2022 post August and 500 points in 2023 so far. Player B won 250 points in 2022 post August and 750 points in 2023 so far. By the ATP system, these players would be ranked the same. But is it really a great way to assess who the best tennis players are right now to count performances from almost a year ago at the same weight as performances from last month? Player B has obviously found a level in 2023 that Player A has been unable to match, and would be expected to be favorite in a head to head encounter, all other things equal. To address this issue, I propose a system where points are weighed differently towards a players’ overall points total dependent on the amount of time passed since the points were earned. From a mathematical standpoint, I tested two different “decay” functions: a sort of reverse exponential decay, and a linear decay. For the exponential decay, imagine a line that starts out relatively flat, but then curves very steeply downwards as it moves along the x axis from left to right. I manipulated the equation for this function to ensure that the highest number of points that could be represented for the tournament is the number of points at “t=1”, or slightly lower than the total number of points the tournament gives, and the lowest number of points that can be represented is slightly greater than 0 when the points were earned 51 weeks ago. For a practical example, imagine that a player earned 250 points at a tournament on the 30th week of last year. In week 31, that tournament might be worth 249 points. However, as time goes on, that tournament will be worth less and less, such that in week 29 of this year, the tournament will be worth practically nothing towards the overall ranking score. The linear decay function works very similarly, except instead of the points distribution following a curved line, it follows a straight line sloped downwards, so that, with each passing day, a constant number of points is shaved from the amount it contributes towards the overall ranking score. For example, if a tournament was worth 250 points in week 30, in week 31, that tournament would be worth points, and so on as the days go by. These two methods differ in that the exponential decay function keeps more of the points for longer and then dumps most of them closer to the end of the 52-week window, thus weighting the points in the 10 to 40 week period relatively higher than the linear decay function, which dumps the same amount of points each week. I found the exponential decay function to be more suited towards my aims. But the outcome is the same. Instead of weighing all points the same regardless of when they were earned, we weigh points earned recently higher, thus getting a better idea of who is performing the best at the current time.

Now to the second drawback of the current ranking system. But first, one thing I forgot to mention earlier. Different tournaments reward a different number of points for the same achievement depending on the “level” of the tournament. So for example, winning Wimbledon is worth 2000 points, whereas winning a lower level tournament can be worth 1000, 500, 250, or fewer points, depending on the tournament. So let’s imagine two players win a tournament of the same level in a single week and get 250 points. However, let’s say one tournament is hosted in Los Cabos and the other in Siberia. Anyone with a brain will want to go hit the beach in Mexico, so higher ranked players will rush to sign up for the sand and fill the entry list. If lower ranked players want to pay for gas this week, they’re gonna have to pack their winter coat and go north to the tundra. Player A wins in Cabo and Player B wins in Siberia. They get the same amount of points, but Player A had to go through a bunch of higher ranked players, whereas Player B had a much easier path to the same amount of points. Why should those 250 points be counted the same? It follows logic that Player A’s points should count for more since he had a harder path. For my college football fans, imagine Notre Dame goes 11-1 whereas an ACC team (just kidding) UCF goes 11-1. When we’re trying to figure out who’s a better team, we don’t just say, “Hey they have the same record, they’re the same level”. We add the context of strength of schedule and say Notre Dame clears, as is the natural order of things. I wanted to try to apply the same idea to tennis rankings. In order to do so, I created an algorithm based on the points a player comes into a tournament with. Each player starts with the number of points they brought in. In the first round, if Player A has a higher number of points than Player B, and Player B beats Player A in an upset, Player A takes the number of points Player B came in with, and Player B “steals” the number of points Player A came in with. If Player A has a lower number of points than Player B, and Player B beats Player A in a “chalky” way, Player A keeps his number of points, and Player B’s points total is set at Player A’s total, which will be lower than he started with. From then on, as you beat a player, you add his number of points to your total, kinda like that massive rock papers scissors we used to play in middle school where you gain a supporter every time you beat them. Thus, at the end of the tournament, players who have played more difficult opponents will have a higher points total than players who have played easier opponents. The last component of this has to do with the differing levels of tournaments and how many points will be available to accumulate. When you’re formulating the multiplier, you don’t want to do it in an absolute sense, because players who play in difficult tournaments where higher ranked players play will naturally have more chances to accrue more performance points will have far larger absolute performance scores than players who play in lower-level tournaments who accrue smaller totals of points just because that’s what’s available to them. Thus, after calculating performance score for each player at a given tournament, I then divide the performance score by the median performance score among all players in the tournament to scale the performance score down. To give a sense for the range of final performance scores, the maximum “performance score” over the past year is Carlos Alcaraz’s performance at Wimbledon 2023, where he beat the #2, #3, and #6 ranked players in the world and earned a performance score of 3.48. The next closest is Dusan Lajovic’s performance at Banja Luka, a lower level tournament, where he still beat Andrey Rublev and Novak Djokovic, two top 10 players for a performance score of 2.99. The lowest possible value for this number is 1. The number of ATP points gained from the tournament are multiplied by the “performance score” to create a new number of points per tournament, and these points are all summed up to create a new ranking of players. One thing to note for tennis nerds; the ATP website does not include results for ITF Futures events, so I could not calculate a “performance score” for those events.

The last point around the rankings system that I wanted to address is related to head to head results. The current ranking system is largely unaffected by head to head results; the difference in number of points gained from one stage to another is too small in the grand scheme of things to matter if you beat one person head to head. However, in college football, it’s practically blasphemy to rank a team that has been beaten higher than the team that beat it. I tend to agree with that. So what I’ve done is create a ranking based on head to head results, and then used a statistical distribution to force my rankings to “tend towards” or “resemble” those head to head rankings. To start, I took the rankings before the first tournament of the year as my base. I created a system where, if Player A is ranked lower than Player B and beats Player B, they take the ranking number of Player A; Player A is pushed down a slot, and all other players below Player A are also pushed down a slot, until the player who was ranked one slot before Player A fills into Player A’s previous ranking. If Player A is ranked higher and beats Player B, nothing changes. I ran this for each match of the year which has results on the ATP website (a few are missing) in chronological order within tournaments and within the year to create one head to head ranking set as of last week’s results. Now, we have one set of rankings which comes from stacking the decayed points method on the performance score method, and one set of head to head rankings. To make the former converge towards the latter, I take the difference between the former and latter rankings. Then, I choose a random number from a triangle distribution with min 0, mode 0.05, and max 0.20. For those who are unaware, a triangle distribution resembles a triangle, but it’s not an equilateral one, it’s more like that gradient sign that tells you to slow down or you’ll die going 100 mph down a 20 degree hill. So the numbers will be concentrated towards 0, most of them will be around 0.05, and very few of them will be around 0.2. I then take this “multiplier”, multiply the difference between the two rankings by this decimal, and add that difference to the original ranking to get the new ranking which will be a combination of the stack and the head to head ranking system. I do this 100 times over with different multipliers for stability’s sake and take the averages of the ranking scores I get. I then sort them in descending order to get my 1 to 2000 or whatever ranking. This is my final ranking system. It has accounted for time in which points have been earned, difficulty of earning said points, and head to head victories over opponents.

So with this system, I think I’ve come up with a more accurate depiction of who the best tennis players are at any given time. It combines various methodologies for ranking players across different sports and adds nuance to the base 52 week rolling system. I scraped all data from the ATP website. If anyone out there has any suggestions or feedback, I’d enjoy it and welcome the discussion. Hope this was interesting for tennis nerds and people who watch sports that are actually entertaining as well.