Imagen. Andre Mcenroe in Pixabay, 2015.

The Scientific Future of Tennis

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This problem situation was written by José Hugo Ochoa Vázquez (hugoochoa@tec.mxwith), with the purpose of serving as discussion material in the classroom; it does not intend to illustrate good or bad administrative practices. The story on this document is based on different people's experiences; some data has been modified at the request of the people and institutions involved.

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The Company

Azsox Group, S.A. de C.V. is a Mexican-based company dedicated to the study of sports with the purpose of improving athletes' performance; Azsox is also engaged in the technical study of the factors that could help to improve the results of athletes in different competitions.

The company has been studying tennis players for several years and gathered a set of variables that they consider influence the performance of the tennis player and the number of possible titles that they can achieve.

Tennis as a Competitive Sport

Carlos Reyes, Azsox's CEO, was reading some tennis statistics and facts about tennis players mentioned in Internet. Some of Carlos' findings were:

> "Since 1999, professional tennis suffered a major change compared to previous decades. Throughout the Open Era of tennis (TennisCompanion, 2023), there have been only a few examples of players that became especially dominant, with the German Steffi Graf being the only one to achieve more than 20 Major singles titles (*Steffi Graf*, n.d.). She also won a gold medal in the 1988 Summer Olympics. The record for men is 14 Majors, achieved by Pete Sampras. The only other player, male or female, besides Graf, to win the Career Golden Slam is Andre Agassi, who also won eight Major titles" (*Olympedia – Olympians who won a Golden Slam in tennis*, n.d.).

"In the 1999 US Open championship, Serena Williams won the first of her 23 Grand Slam singles titles, the most amongst women. In that same year, she won the first of her 14 doubles titles, all of them alongside her sister, Venus. Both won Olympic gold medals in the "singles" and "doubles" categories, and they later won seven Grand Slam "singles" titles" (*Olympedia – Olympians who won a Golden Slam in tennis*, s. f.).

"Four years after the first victory of Serena Williams, Roger Federer won the first of his 20 Grand Slam titles in the Wimbledon tournament, which he won seven more times. For many years, he held the record of most majors won by a man and still holds several records, including the highest number of consecutive weeks ranked as *number one in the world* in tennis. Two years later, Rafael Nadal won his first major's at the *Roland Garros* tournament. Commonly regarded as the best player in clay surface, he has won 22 Grand Slam titles, 14 of which he obtained in the *French Open* tournament. Nadal has also won two Olympic gold medals, both in singles and doubles; he is the second one overall in major titles, only behind Novak Djokovic, a 23-time Grand Slam winner, ten-time winner of the *Australian Open* championship and the player with the most non-consecutive weeks ranked as *number one in the world"* (*Olympedia – Olympians who won a Golden Slam in tennis*, s. f.).

After reading those news and facts, Carlos met with the complete staff of Azsox's R&I Department. In that meeting, Carlos asked them the following questions: What happened to tennis? How is it that Novak Djokovic still dominates the sport in 2024, competing against players that are decades younger than he is? Why do the so-called *Big Three* (Richter, 2023) have won 65 of the last 81 singles Grand Slam tournaments? What makes a sports champion? More importantly, what makes a tennis world champion? Will we ever see another Serena Williams or another person at the same level as hers?

After those questions, Carlos told them: "I know that we have the data to find the answers to my questions. The data we have would not only answer my questions but would also help to prepare a presentation for the Mexican Tennis Federation; we have signed a contract with this organization, and we need to present them the findings next week. I need you to find how the variables we have could provide informed answers; I need the results of the analysis next week, when we will present a model to the Mexican Tennis Federation."

José Guzmán, leader of Azsox's R&I Department, presented to his colleagues some data that,according to him,could be useful to accomplish Carlos Reyes' expectations. Data had previously been collected and identified by several persons at Azsox:

The Independent Variables

Azsox has identified the variables that could affect the number of titles that a tennis player can achieve (see Table 1).

Table 1. Variables that could affect the number of titles that a tennis player can achieve.

Name of the variable	Meaning
AGE	Age at which the player became professional
HEIGHT	Player's height (cm)
YEARS	Number of years in the circuit
WEIGHT	Player's weight (kg)
WHR	Player's height ratio
DEX	Right (1) or Left (0) handedness
FSER	Average percentage of first serves in (%)
SPSER	Average speed of first serve (mph)
UERR	Average number of unforced errors per set
EARN	Career prize earnings in dollars
SPONS	2023 Sponsorship earnings in dollars

Source. *Players,* s. f.

The independent variable (CHAMP) is a number calculated as the sum of the following data (Source: *Players,* s. f.):

1. Number of Majors/Grand Slam singles titles
2. Number of Olympic gold medals
3. Number of Olympic silver medals, multiplied by a factor of 0.75
4. Number of Masters1000 or WTA1000 titles, multiplied by a factor of 0.75
5. Number of ATP500 or WTA500 titles, multiplied by a factor of 0.5
6. Number of ATP250 or WTA250 titles, multiplied by a factor of 0.3

Notes:

Note #1.-The factors applied to each of the titles are arbitrary, decided by Azsox's, based on the importance of each of the tournaments (e.g., Grand Slams are the most prestigious and difficult tournaments to win).

Note #2.-The occurrence (e.g., there is a significant greater number of ATP250 and WTA250 tournaments than Masters 1000 and WTA1000 tournaments) and special consideration for Olympic games (they grant no points for players' rankings but are very prestigious and are held only once every four years, hence given the same weight as Majors).

José provided the rest of the team with the following database. **SEE HERE.**

This database includes information for active ATP[1] players in either the Top 50 ranking as of January 2024 and/or winners of, at least, one Grand Slam title (*Rankings | Pepperstone ATP Rankings (Individual) | ATP Tour | Tennis | ATP Tour | Tennis*, s. f.).

The Model

José Guzmán also proposed to the rest of Azsox's R&I Department to present a linear model to the Mexican Tennis Federation, including the significant variables that most influence athletes' performance. According to José, it would have to comply with the *Ordinary Least Squares* efficient model assumptions, most importantly the homoscedasticity of the residuals and the linear independence between the *regressors*, also known as "assumption of no multicollinearity".

The final model, according to Jose´s proposal, must be economically significant, as well as tested for normality of its residuals and for the global and individual statistical significance of the variables' coefficients.

Testing and Interpreting the Model

"The final report that Azsox would deliver, José mentioned, must be tested using a scenario analysis where the pessimistic scenario will forecast the possible championships of a player with all the variables in percentile 15, the most likely scenario will use a percentile 30 and the optimistic scenario will use a percentile 40".

José also proposed to the rest of the team to include in the final report the interpretation of each significant coefficient for the Mexican Tennis Federation to make plans on which of the players' attributes should be promoted, worked, and improved to have an ATP champion.

All the members of Azsox's R&I Department accepted Jose's proposals and started to work.

[1] Association of Tennis Professionals

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