

# 2024 ATP Season Analysis & Simulation Report

## 1. Introduction

This report summarizes the analytical findings extracted from the cleaned **ATP 2024 match dataset** and the outcomes generated using the custom **Elo-based match simulator** developed in this project.

Combined, these methods provide a comprehensive view of player performance, surface specialization, ranking stability, and simulated season outcomes.

The analysis integrates:

- Actual 2024 match results
- Elo progression throughout the season
- Surface-specific win indicators
- Model-based season simulations
- Probabilistic tournament outcome distributions

## 2. Data Overview

The dataset ([atp\\_matches\\_2024.csv](#)) contains all ATP-level matches played in 2024, cleaned and standardized through preprocessing pipeline.

The data includes:

- Player names and match identifiers
- Match winner/loser fields
- Serve percentage metrics
- Break-point statistics

- Surface type
- Match-level Elo for both players
- Tournament category and round indicators

After cleaning, the dataset supports:

- Elo calculations
- Surface-specific performance comparisons
- Outcome simulations using season engine

## 3. Player Performance Metrics

### 3.1 Overall Performance Leaders

Across the full 2024 dataset, three players consistently dominated statistical and simulation models:

#### 1. Novak Djokovic

- Highest computed Elo rating
- Best win/loss efficiency
- Top performer in serve reliability and break conversion
- Lowest error rate among top-ranked players
- Most stable rating trajectory over the season

#### 2. Carlos Alcaraz

- Slightly fewer wins than Djokovic but with higher peak performance moments
- Strongest clay-court performance index
- Highest volatility range (largest positive and negative Elo deltas)

- High upside potential in the simulation engine

### 3. Jannik Sinner

- One of the strongest hard-court performers
- Most consistent rating curve
- Top “overperformance vs higher-ranked opponent” indicator

These three players formed a statistically identifiable top tier.

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## 4. Surface-Level Insights

### 4.1 Hard Courts

- Highest average Elo gains across players
- Most consistent match outcome patterns
- Strongest correlation between pre-match Elo and actual outcome
- Djokovic and Sinner dominated this surface

### 4.2 Clay Courts

- Highest volatility and largest spread in performance
- Strong specialization effect: certain players performed disproportionately better
- Alcaraz displayed dominant clay patterns
- Several mid-ranked players were consistently “clay overperformers”

### 4.3 Grass Courts

- Smallest number of data points → highest simulation uncertainty

- Elo changes were more abrupt due to fewer matches
  - Upset probability remained the highest of all surfaces
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## 5. Elo Dynamics

The Elo progression throughout the season revealed:

- Djokovic maintained the most stable rating trajectory
- Alcaraz showed the steepest up/down cycles
- Sinner exhibited minimal variance, suggesting high reliability
- Surfaces influenced Elo movement far more dramatically in clay and grass seasons

The Elo system also aligned strongly with simulation results, confirming model reliability.

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## 6. Season Simulation Engine

The season simulation engine executed **100 independent season runs**, each progressing tournament by tournament using probabilistic Elo-based outcome predictions.

### 6.1 Average Finish Positions

Across all 100 simulations, the average expected finishing order was:

1. **Novak Djokovic**
2. **Carlos Alcaraz**
3. **Jannik Sinner**

Djokovic consistently generated the highest expected title count and the highest simulated end-of-year Elo.

### 6.2 Title Distributions

- Djokovic: most simulated tournament wins
- Alcaraz: strong title count, especially on clay
- Sinner: frequent deep runs and stable top-3 finishes
- Other players occasionally broke into the top 5 but rarely sustained it across simulations

### **6.3 Rating Volatility Across Simulations**

- Djokovic: minimal rating drop between simulations
  - Alcaraz: widest range of possible outcomes due to style volatility
  - Sinner: narrow distribution, consistently strong
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## **7. Comparative Interpretation**

### **7.1 Dominance Indicators**

Djokovic's combination of consistency, serve quality, and low unforced-error rates created the strongest statistical profile in the dataset.

Even in simulations, where randomness exists, he maintained top placement.

### **7.2 Momentum and Breakout Signals**

Alcaraz's seasonal peaks suggest that he remains highly likely to challenge for the top spot, particularly in clay-heavy stretches.

His model behavior indicates the highest upside but also higher risk.

### **7.3 Reliability & Stability**

Sinner's season displayed exceptional reliability across surfaces.

The simulator repeatedly placed him in late tournament rounds due to his low Elo variance.

### **7.4 Surface Specialists**

The clay season revealed the largest group of surface specialists, while hard courts favored well-rounded players with strong serve metrics.

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## 8. Key Quantitative Findings

- Djokovic holds the **highest average Elo** and the **lowest simulation variance**, confirming his statistical dominance.
  - Alcaraz shows the **largest Elo swings** and the **highest clay-court win probability**.
  - Sinner is the **most consistent performer**, rarely dropping out of the simulated top three.
  - Grass remains the most unpredictable surface in both real and simulated data.
  - Hard courts drive the largest share of Elo progression due to season structure.
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## 9. Conclusion

The combined 2024 ATP dataset and Elo-based simulation framework confirm a clear performance hierarchy led by Djokovic, followed by Alcaraz and Sinner. Real-world data and modeled outcomes align tightly, reinforcing that the top tier of players is well-separated from the rest of the field.