Performative Statistics in Monza Circuit vs Overall Championship

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1. Abstract

This project visualizes key patterns in Formula 1 by examining how speed, competitive performance, and driver representation evolve across seasons. We first analyze fifteen years of fastest laps at Monza, the sport's most speed-dependent circuit, to illustrate how engineering, aerodynamics, and regulation changes influence long-term performance trends. Using FIA-based datasets from Wikipedia and Kaggle, we then compare Monza winners with season-ending World Drivers' and Constructors' Champions to evaluate whether dominance on a pure-pace track aligns with year-long success. Our final visualization displays the driver grid by nationality over the years to highlight global participation patterns. Each graphic uses annotated markers, figure-ground separation, and interactive tooltips to keep the design clear for both F1 fans and early-career engineers. Together, these visualizations provide an accessible narrative that connects car development, competitive outcomes, and international talent distribution within modern Formula 1.

2. Background & Purpose

Formula 1 generates immense amounts of performance data each season, however fans and early-career engineers often struggle to see how individual race outcomes, long-term speed development, and global driver participation connect to one another. This project addresses that gap by organizing three related stories that reveal broader patterns within the sport. The first focuses on Monza's fastest laps over the last fifteen years, using the "Temple of Speed" as a lens to understand how engineering progress and regulation changes influence raw performance. The second examines whether dominance at Monza corresponds to season-long success by comparing Monza winners with World Drivers' and Constructors' Champions. The third highlights which countries contribute the most drivers to the grid, providing context on talent development and global representation. Together, these visuals help F1 enthusiasts interpret historical trends more clearly and support engineering-focused viewers who want an intuitive summary of how speed, competitiveness, and driver origins shape modern Formula 1.

3. Basis & Approach

3.1 Data Preparation

Since the available files spanned several decades, we restricted all observations to the last fifteen seasons to maintain consistency in timing technology, regulatory context, and data completeness. Using circuits.csv and races.csv, we identified and isolated Monza-specific events, then filtered related datasets (lap_times.csv, results.csv, driver_standings.csv, and constructor_standings.csv) according to each objective. This approach ensured that the analysis focused only on relevant seasons, drivers, and circuits without altering the structure of the original FIA-derived files. Through this filtering, we established focused subsets that allowed us to study long-term speed progression, compare Monza winners to season champions, and examine the national distribution of drivers competing on the grid.

3.2 Visualization Design Approach

The design decisions were guided by the narrative goals associated with each objective. A line chart was used to represent the evolution of fastest laps at Monza because continuous trends and regulatory effects are most effectively interpreted through a temporal visual structure. Bar charts were selected to compare Monza winners with World Drivers' and Constructors' Champions since categorical differences in points and rankings are easier to evaluate through discrete visual groupings. A horizontal bar chart was used for the nationality visualization to emphasize ranking and support rapid comparison across countries. Across all visualizations, we applied figure ground separation, layered annotations, and an F1 inspired but accessibility conscious color palette to maintain visual clarity. Interactive tooltips were added to provide supplementary details such as lap times, driver names, team information, or final points totals without overwhelming the main presentation. These choices collectively support the project's purpose by creating a coherent and interpretable visual summary of speed evolution, competitive outcomes, and global participation in Formula 1.

4. Abstraction & Aggregation

4.1 Abstraction

We applied abstraction by focusing specifically on the Monza Circuit, a track defined by long straights and minimal technical sections that emphasize engine power and aerodynamic efficiency. This allowed us to examine how performance on a speed oriented circuit relates to broader season outcomes. We framed the abstraction conceptually by identifying the Monza race

winner for each of the last fifteen seasons and comparing that result with the final season standings. Our goal was to see whether drivers who excel at Monza also finish within the top three of the World Drivers Championship. We also wanted to check other factors such as individual constructor's performance, driver's nationality and other regulatory changes that would affect that season's performance. The simplest way to achieve that was by comparing the points scored by drivers and constructors throughout the season.

4.2 Aggregation

We used aggregation to summarize detailed race and lap data into broader performance indicators that supported our comparison of Monza results with season end standings. After isolating the last fifteen Monza races, we aggregated results at the driver level by examining final points and final rankings in the World Drivers Championship. This helped reduce noise from isolated events such as crashes or weather related disruptions and allowed us to focus on overall competitiveness rather than single race anomalies. By converting detailed records into concise driver level summaries, we were able to evaluate whether the Monza winner demonstrated consistent performance throughout the season and whether their racing strength at a high speed circuit aligned with finishing within the top tier of the championship standings.

5. Visualization Techniques

5.1 Techniques to improve Visual Clarity

We used several techniques to ensure that viewers could identify key information quickly. Figure–ground separation helped important elements stand out clearly against muted backgrounds, such as the colored bars in the nationality visualization and the main trend line in the Monza plot. This supports low-level perceptual processes by allowing viewers to recognize differences in magnitude without reading specific values. We reinforced this through anchored baselines and subtle reference lines, which make relative comparisons more accurate and highlight long-term changes in lap times or driver counts. Together, these choices prioritize pattern recognition and reduce cognitive effort during initial viewing.

5.2 Interactivity with the Visualizations

To guide viewers across different visualizations, we applied visual momentum by keeping color choices, spacing, and typographic styles consistent. This helped users transition smoothly between analyses such as Monza performance and nationality distributions. We also included details-on-demand through interactive tooltips, which reveal additional information like lap times, points, driver names, or team data only when needed. This allowed us to maintain clean

visual layouts while still supporting deeper exploration for viewers who want more context. The combination of stable visual structure and optional detail encourages both quick understanding and further analysis. We've also added golden stars into the visualisations to signify major FIA regulation changes, when the reader hovers over the star further details are revealed in a brief manner.

5.3 Tradeoffs and Design Decisions

A central tradeoff was choosing between visually rich F1 color themes and ensuring accessibility. Many official team colors have low contrast or pose challenges for color-deficient viewers, so we adapted a simplified palette that retains F1 familiarity while remaining readable. Another tradeoff involved limiting visual clutter. Full lap-level or driver-level detail would overwhelm the viewer, so we relied on aggregation and focused highlights. Interactive tooltips helped resolve this by presenting additional information without crowding the main display.

6. Overview of Visualization

6.1 Design Intent

The goal of these visualizations is to examine whether performance at the Monza Circuit is indicative of overall Formula 1 season success. Because Monza is characterized by sustained high-speed racing and unique aerodynamic demands, the visualizations explore whether strong results at this track correspond to championship-level outcomes or instead reflect track-specific advantages that do not carry across the season. The intended audience includes Formula 1 fans seeking clear season-level comparisons and early-career engineers who value structured, data-driven analysis of performance trends. Design choices emphasize clarity and comparability to support interpretation of long-term patterns while remaining accessible to both audiences.

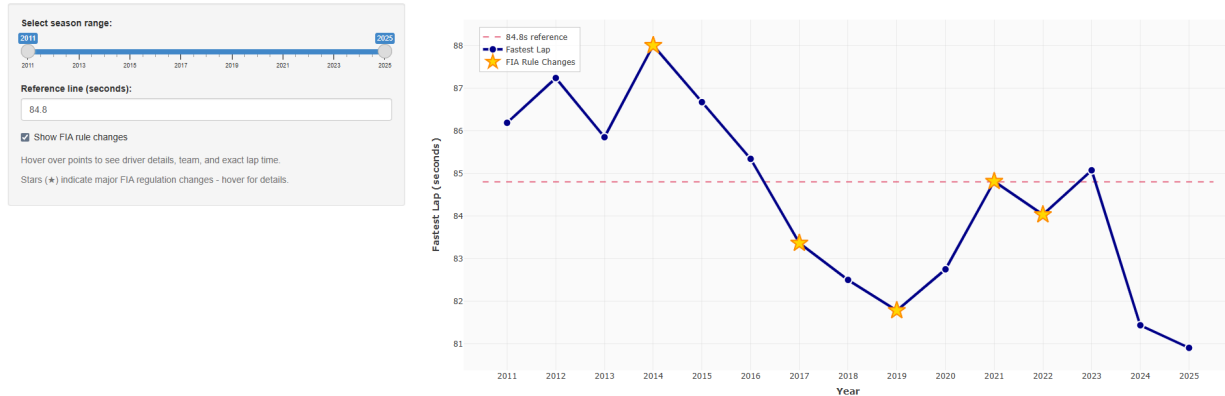## 6.2a Visualization 1: Fastest Lap Trends at Monza Over Fifteen Seasons

Fig.1. Fastest Lap Times at Monza Circuit

The first visualization shows the fastest lap time at Monza for each season across the last fifteen years. A dashed reference line around 84 seconds serves as a benchmark with the overall median of the dataset lying there. The compact figure layout makes year-to-year variations more visible and emphasizes the impact of technological change, aerodynamic updates, and engine regulations on raw lap performance. We can see significant performance changes right around when FIA introduced new regulations, such as V6 hybrid engines in 2014 or wider ground effect designs in 2021.
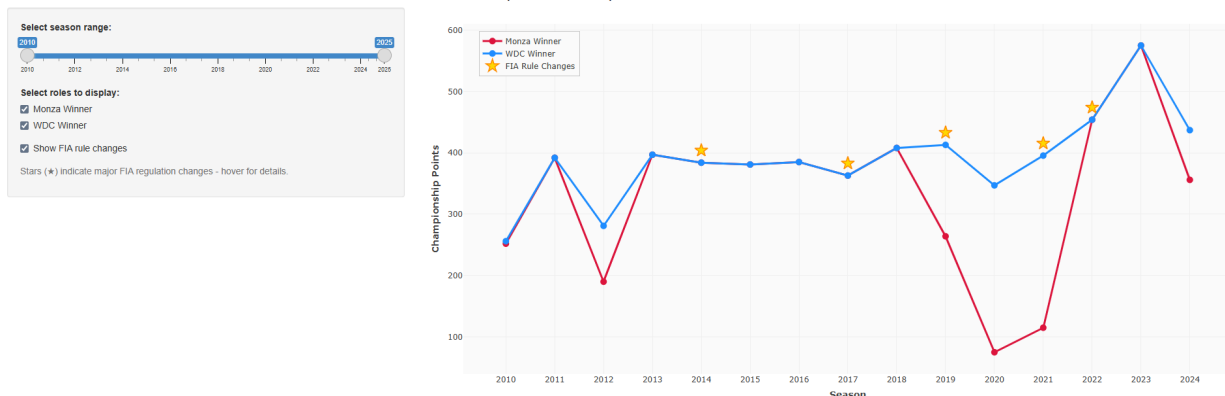
6.2b Visualization 2: Monza Winners vs World Drivers' Champions

The next visualization is a line chart that compares the end-of-season points of Monza race winners with those of the World Drivers' Champions from 2010 to 2024. We used two contrasting color channels and slightly thicker lines to create a clean separation between the two groups. The purpose of this visualization is to help viewers identify seasons where Monza driver performance aligned with championship winners and where the gap between the two was substantial. This contrast supports reasoning about driver consistency, car characteristics, and the influence of specific regulation eras (2019-2022 as marked by the stars).

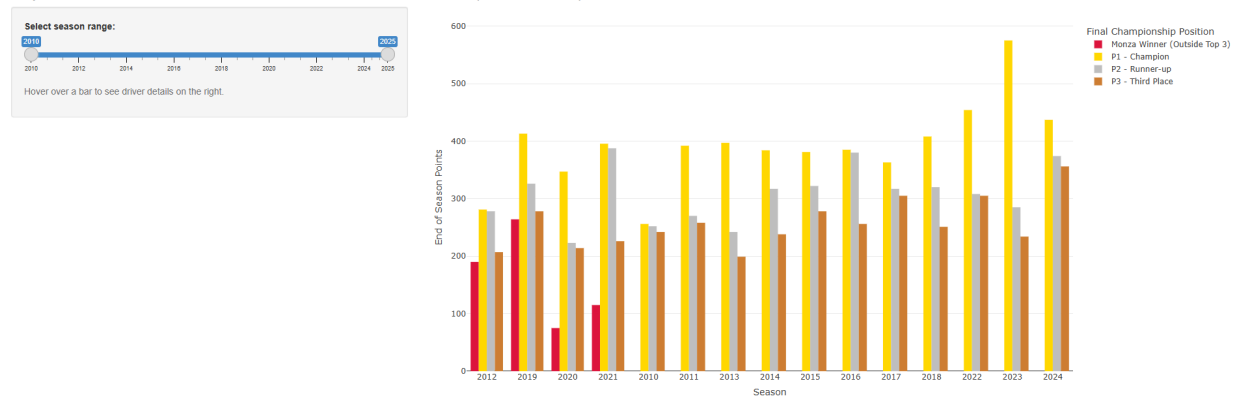# 6.2c Visualization 3: Top 3 Drivers vs Monza Winners out of Top 3

Fig.3. Top 3 WDC Drivers vs Monza Winners (Out of Top 3)

The third visualization expands the perspective by comparing the top three finishers in the World Drivers' Championship with any Monza winner who did not finish the season inside the top three. Gold, silver, and bronze were used to reflect podium conventions, and a distinct red was used for Monza winners outside the top three. The major idea behind this visualization is to highlight and compare how often Monza winners end up within the top 3, if they do NOT win the WDC. It also highlights how often Monza winners fall outside the championship's top positions. So we can highlight the overall competitiveness of an average Monza GP winner to the Top 3 consistent drivers through the season and factor it to a one-time wonder or championship contender's performance.

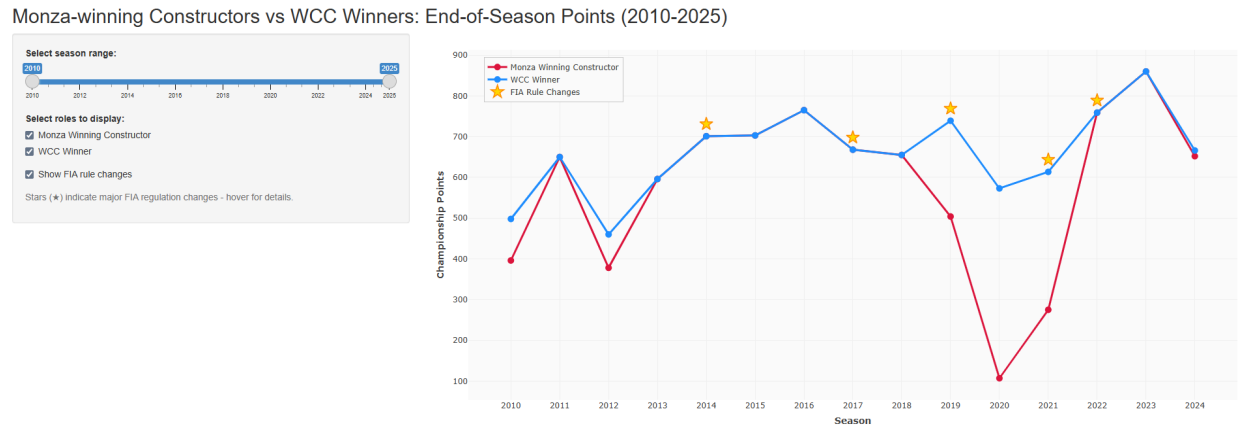## 6.2d Visualization 4: Monza Winners vs World Constructors Champions

Fig.4. Monza Winners vs World Constructors Champions

This line chart mirrors the structure of the second visualization but focuses on constructors instead of drivers. It compares the Monza-winning constructor to the World Constructors' Champion for each year. Keeping the structure parallel to Visualization 2 creates visual consistency and supports smooth transitions between driver-level and team-level interpretations. By placing both views side by side, users can identify whether Monza is more predictive of championship success at the team level than at the driver level.

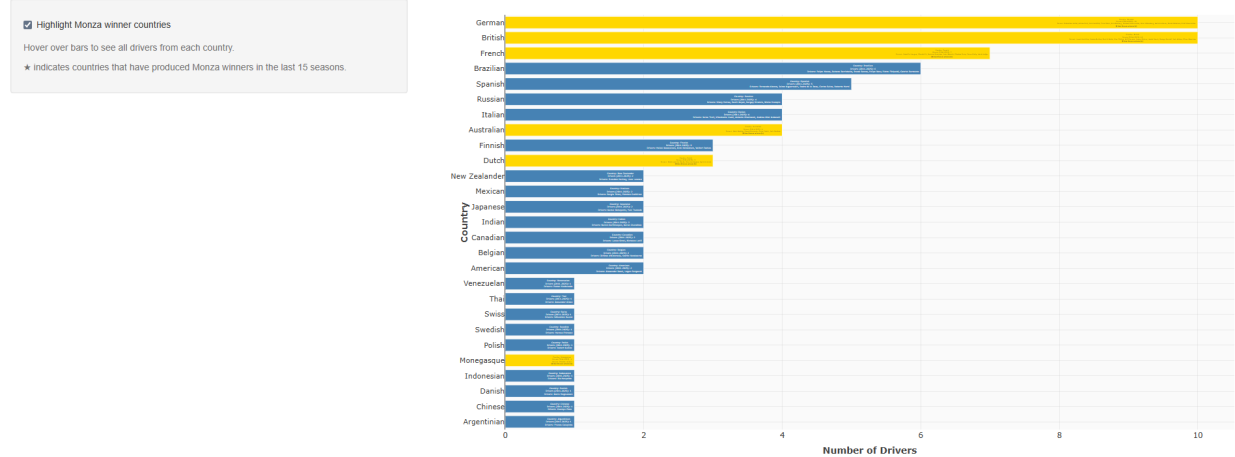## 6.2e Visualization 5: Driver Nationality Distribution

Fig.4. Driver Nationality Distribution

This horizontal bar chart presents the nationality distribution of drivers entering the F1 through the last 15 seasons. Bars are ordered from highest to lowest representation, and each bar is labeled directly with its driver count. The golden color highlights if the countries have produced a Monza winning driver. This visualization complements the performance-focused plots by showing the global makeup of the driver grid and providing broader context for where emerging talent comes from & if their culture has impacted their performance at F1's fastest circuit.

6.3 Ideas to expand upon

A natural next step would be to repeat this analysis for additional circuits with strong identities, such as Abu Dhabi (Yas Marina) or UK (Silverstone), and compare how performance at different track types relates to championship outcomes. Another possible direction is to integrate contextual variables such as weather conditions, tire compounds, pit strategy timing, or safety-car interruptions. These additions would deepen the analysis and help explain why Monza performance aligns with season outcomes in some years but not others.

7. Conclusion

This project set out to examine whether performance at the Monza Circuit reflects broader season trends in Formula 1 and to see how results from a uniquely high-speed track relate to championship outcomes. Our approach involved filtering and restructuring fifteen seasons of race, standings, and lap-time data, then applying abstraction and aggregation to focus on comparisons that were meaningful at the season level. The final visualizations show that while some Monza winners also lead the championship, many do not, indicating that Monza often highlights specialized strengths rather than season-long consistency. Similar patterns appear at the constructor level, where strong Monza results do not always translate into championship dominance. The visualizations are effective because they maintain clarity across long time spans, use consistent design choices, and support direct comparison across seasons. These findings are useful for fans, analysts, and engineers who want to understand how circuit-specific performance fits into the larger competitive picture of Formula 1.

A. References

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B. AI Use Plan

AI tools, ChatGPT & Claude AI, have been utilized in this project. They have been deployed at areas where we needed grammar & literature related issues, since our team's majority doesn't utilize English as our first language, it was deemed useful to use ChatGPT as an assistant to correct our mistakes, vocabulary & sentence structures. ClaudeAI has been instrumental in expanding R code throughout our learning experience of this course, correcting syntax and resolving bugs we couldn't find solutions to after discussing amongst peers have been resolved by Claude's guidance.