



SAPIENZA  
UNIVERSITÀ DI ROMA

# F1-VA

Exploring Lap Performance and Tyre Degradation in Formula 1 through Visual Analytics

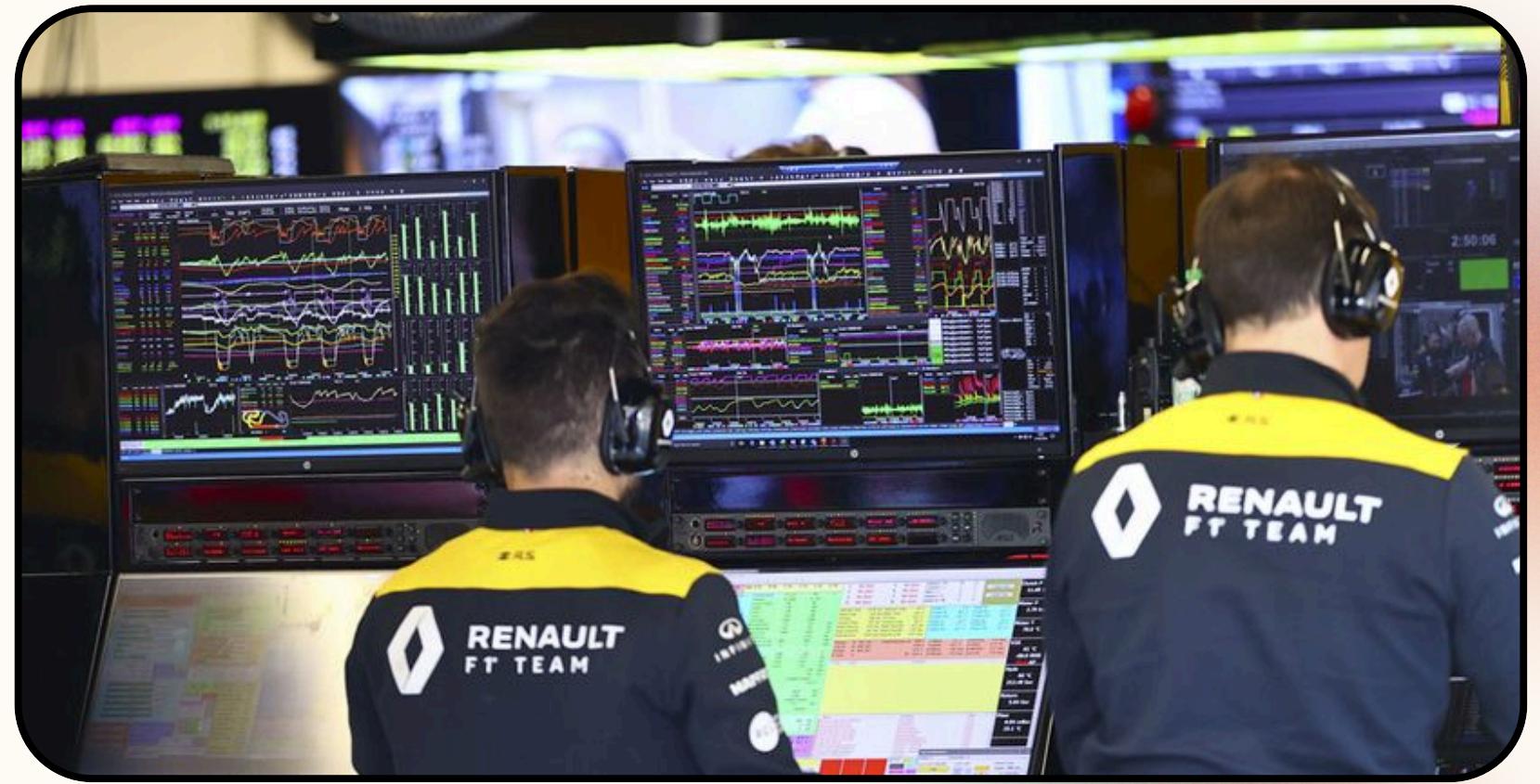
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**Pisano Raffaele**  
Visual Analytics

# *Introduction* - Context & Motivation

## *Formula 1 as a Data-Driven Sport*

- Team strengths & weaknesses
- Performance under different conditions
- Tyre degradation trends
- Useful for predicting race outcomes



**Problem:** data is often poorly visualized and hard to access → difficult for enthusiasts to analyze and compare drivers or teams

# ***Introduction*** – Project Goal

## ***Interactive Visual Analytics Dashboard***

- Organize and present 2025 F1 lap data in a clear, engaging way
- Provide tools for:
  - Exploring lap performance patterns
  - Understanding tyre compound dynamics
  - Comparing driver & team performance
  - Discover insights

# **Related Works** - Existing Online Platforms

- ***F1 Live Timing*** → real-time, tabular, no past races, limited analysis
- ***F1 Tempo*** → lap-level focus, simple charts, lacks advanced tools
- ***Rapit*** → interactive charts & tyre strategy, but shallow analysis
- ***PitWall*** → large historical DB (since 1950), text-heavy, weak visuals
- ***F1 Dash*** → live race following, casual fans, no deep analytics
- ***Formula1 Dashboard*** → static season stats, limited interactivity

Most platforms: live-oriented OR static summaries → limited for deep lap-level exploration.

# **Related Works - Existing Papers**

## ***Visualization of Formula One Racing Results [1]***

- Interactive tools with timelines, stacked bars & statistics for multi-season analysis

## ***Personalized Visualization in Formula One Racing [2]***

- Views tailored to team roles (drivers, analysts, principals) → highlights need for customization

## ***F1 Data Analysis [3]***

- Interactive dashboards with bar charts, stats, trend lines for driver comparisons

## ***Automation of Data Analysis in Formula 1 [4]***

- Real-time dashboards (Python/Dash) to handle telemetry complexity, emphasizing automation & scalability

# **Dataset**

The dataset used in this project originates from **FastF1 API**, it focuses specifically on races session of **2025 season**.

Incomplet or invalid laps were deleted during preprocessing phase.

The final dataset consists of **9,900** laps, described by **10** dimensions:

Driver – LapTime – LapNumber – Compound – TyreLife

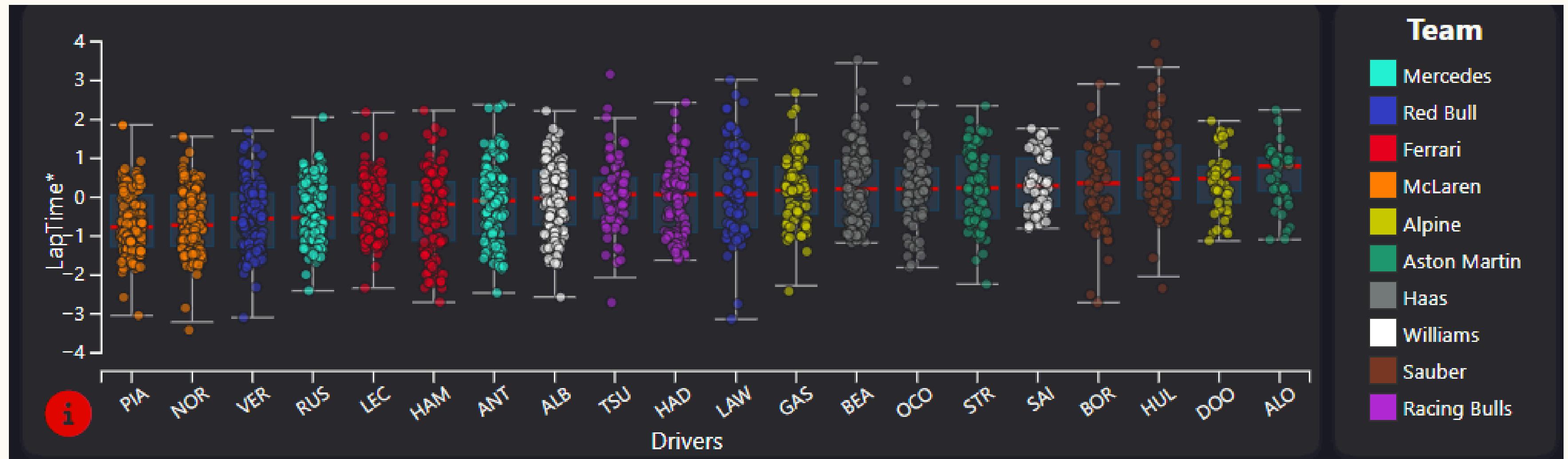
Team – Track – Rainfall – TrackTemp – LapTime\_norm



# System - Description

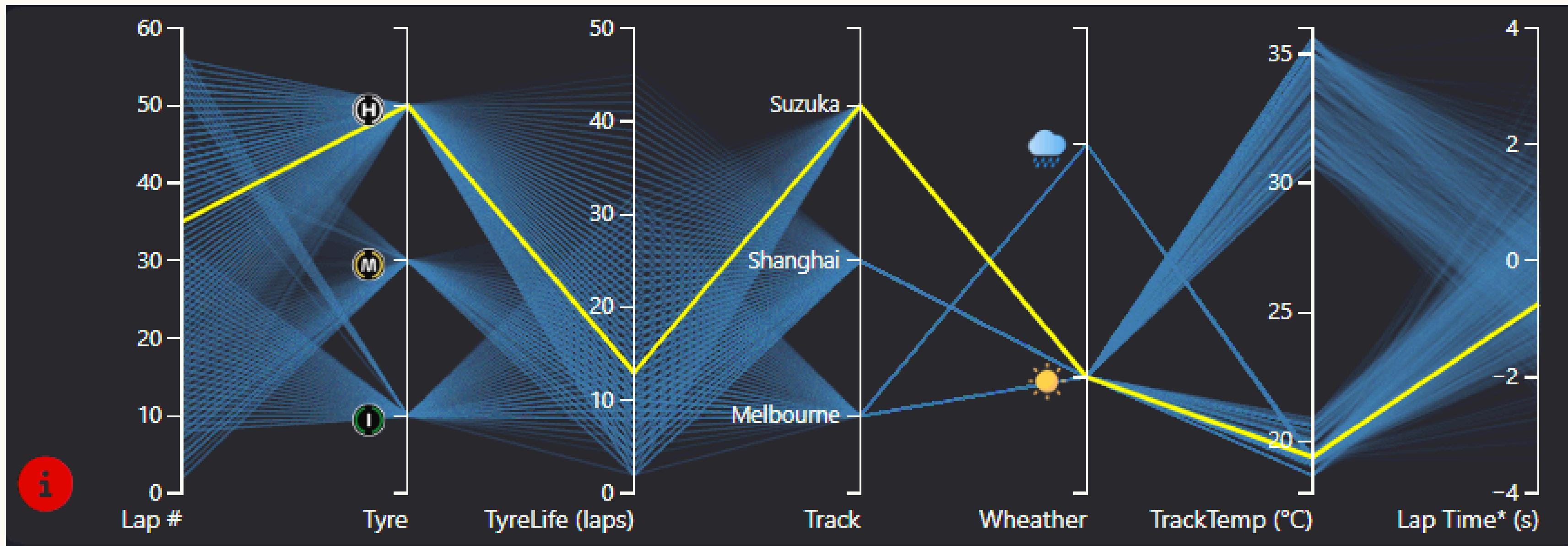
The dashboard integrates **six main charts**, each serving a specific purpose for analyzing Formula 1 lap data:

- **Boxplot** → Distribution of normalized lap times (LapTime\*) per driver.



# System - Description

- **Parallel Coordinates** → Multidimensional view of lap attributes and correlations.



# System - Description

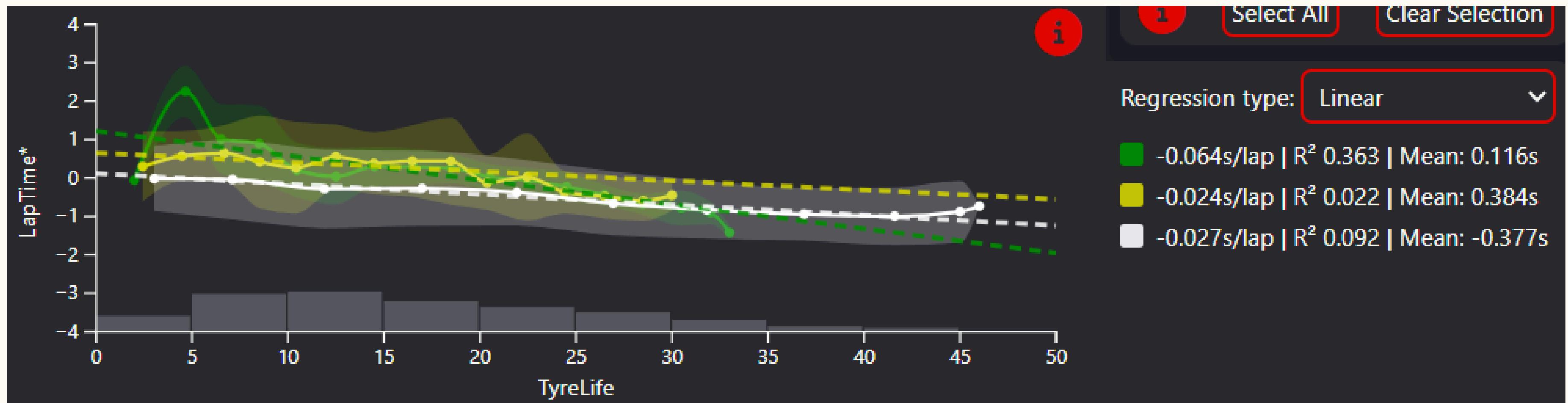
**Table** → Tabular representation of lap data, sortable by various parameters.

✓	ID ▲	Driver	Team	Track	Lap #	LapTime*	LapTime	Tyre	TyreLife	TrackTemp	Weather	Cluster	✖
<input type="checkbox"/>	0	VER		Melbourne	8	1.71 sec	96.83 sec		8	19.1 °C		2	
<input type="checkbox"/>	1	VER		Melbourne	9	0.83 sec	94.31 sec		9	19.1 °C		2	
<input type="checkbox"/>	2	VER		Melbourne	10	0.25 sec	92.65 sec		10	19.1 °C		2	
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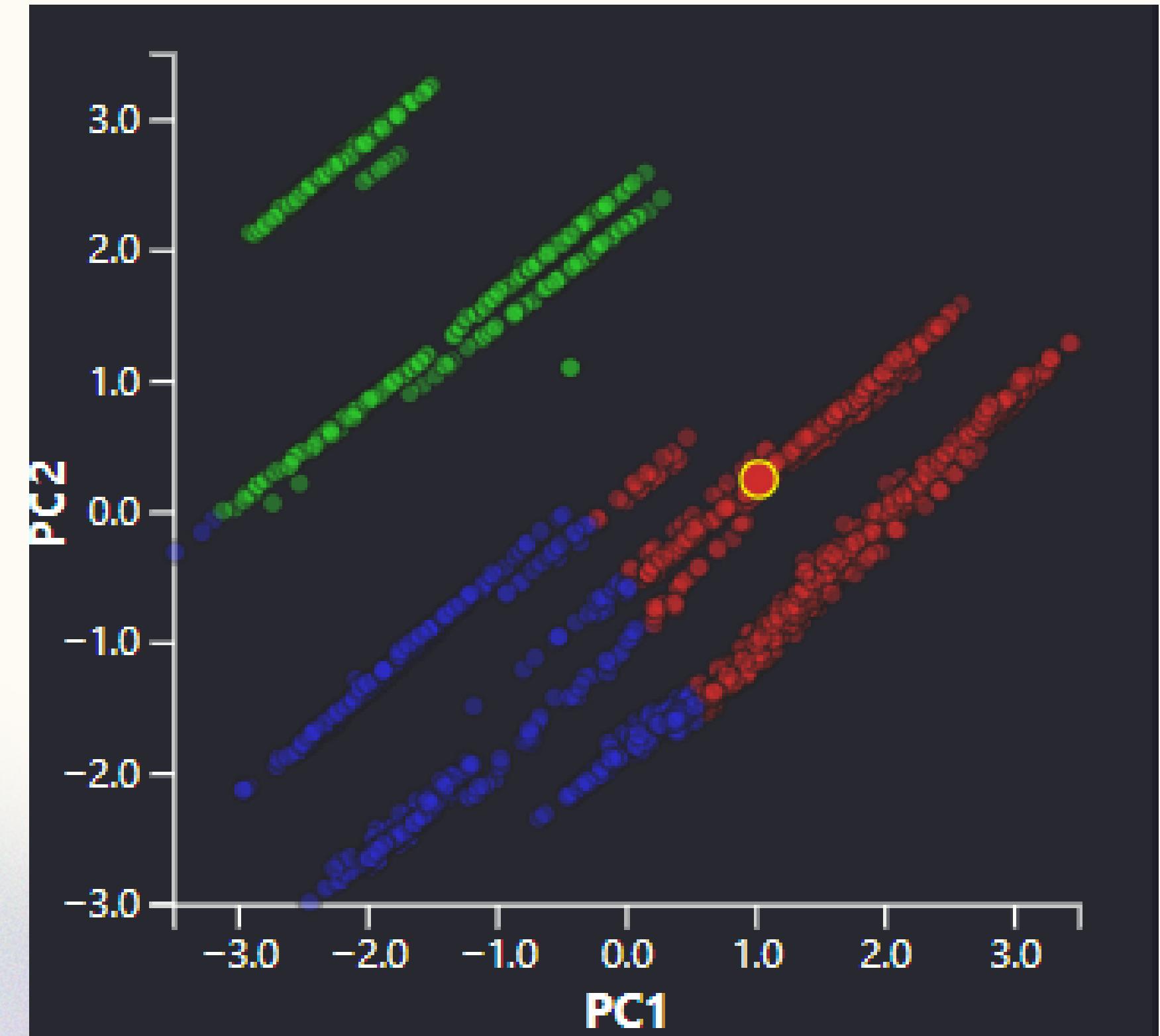
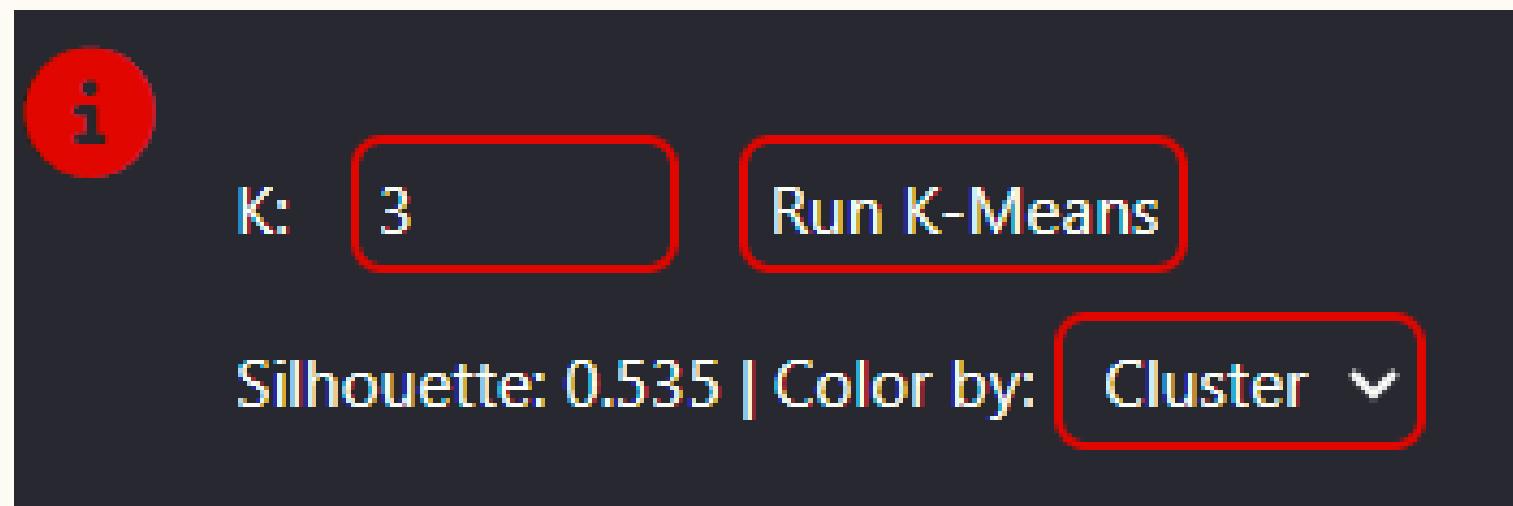
# System - Description

**Tyre Wear Line Plot** → Relation between tyre life and lap performance.



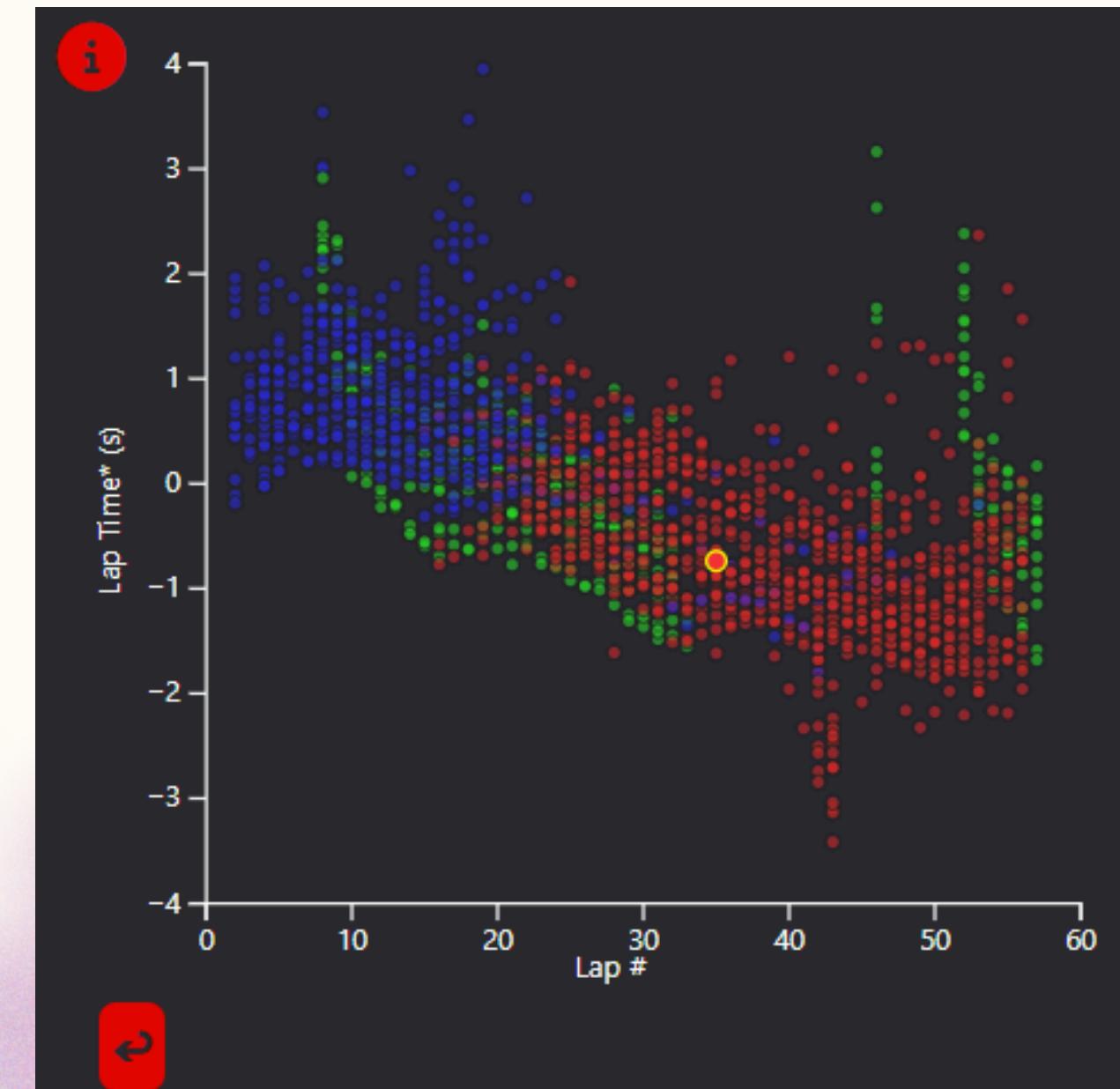
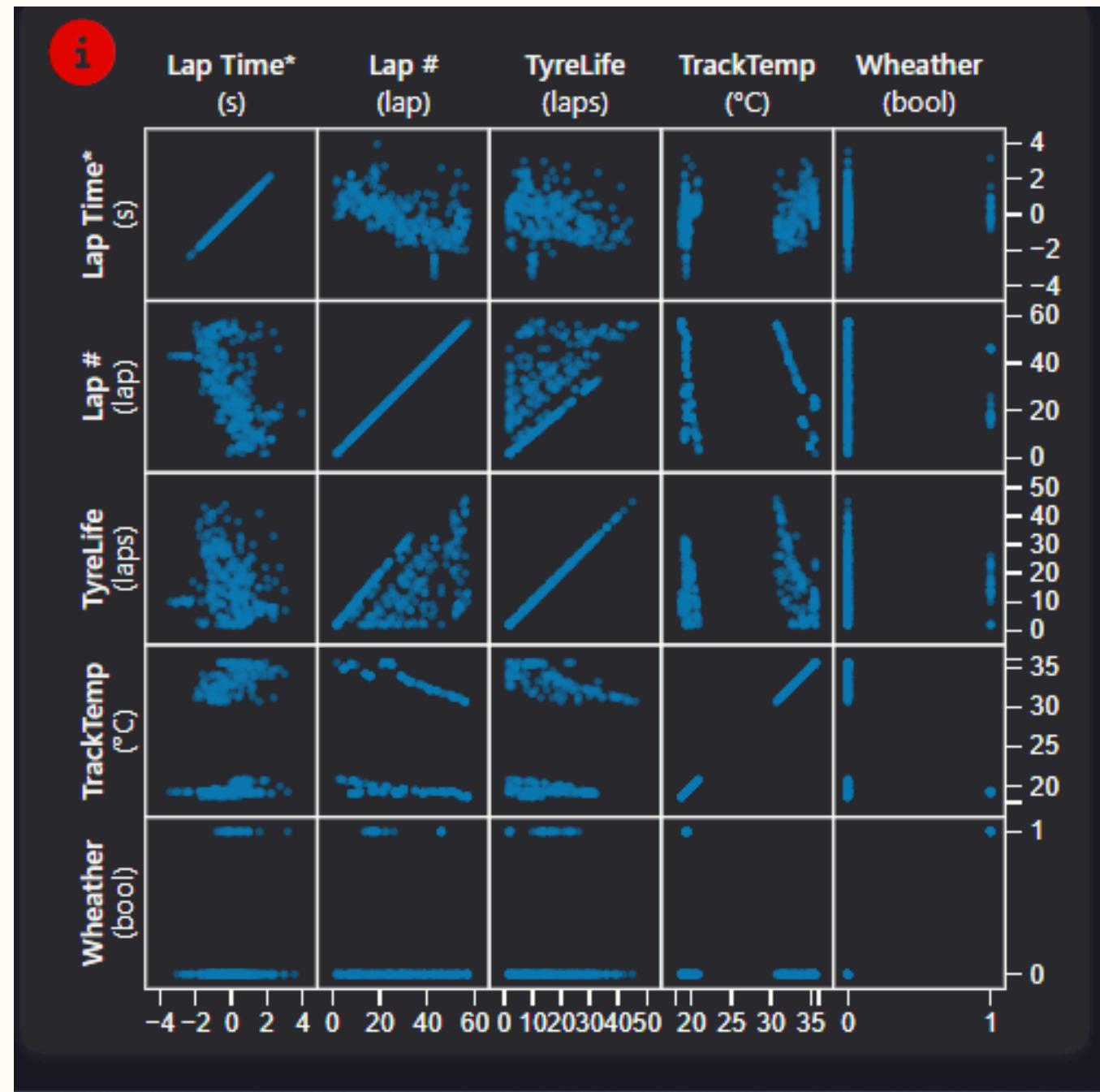
# System - Description

**PCA Scatter Plot** → Dimensionality reduction to identify performance patterns.



# System - Description

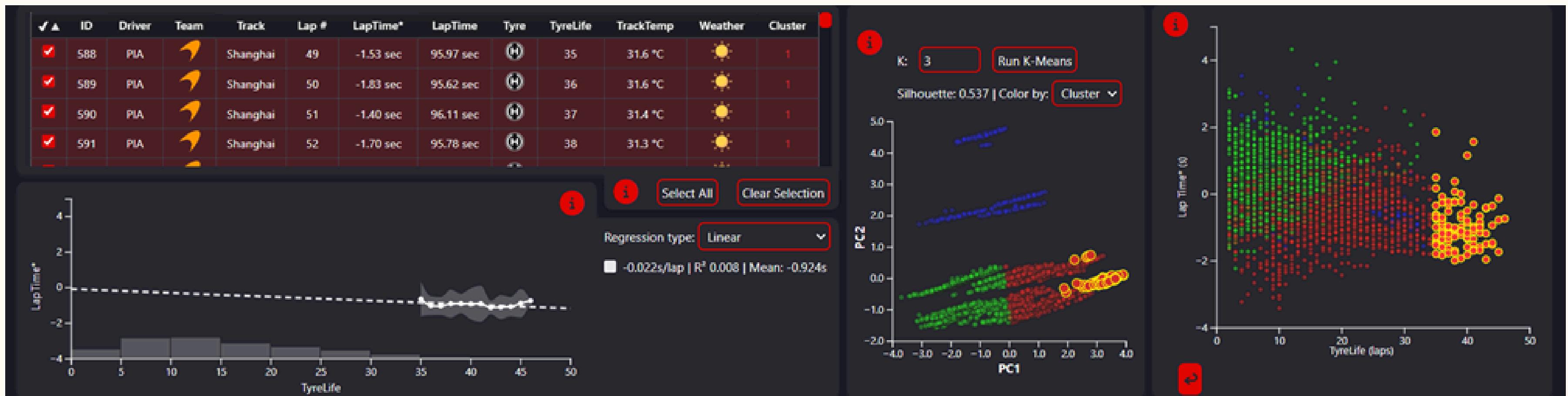
**Scatterplot Matrix (SPLOM)** → Pairwise correlations between lap variables.



# System - Insights

## Tire Life and Performance

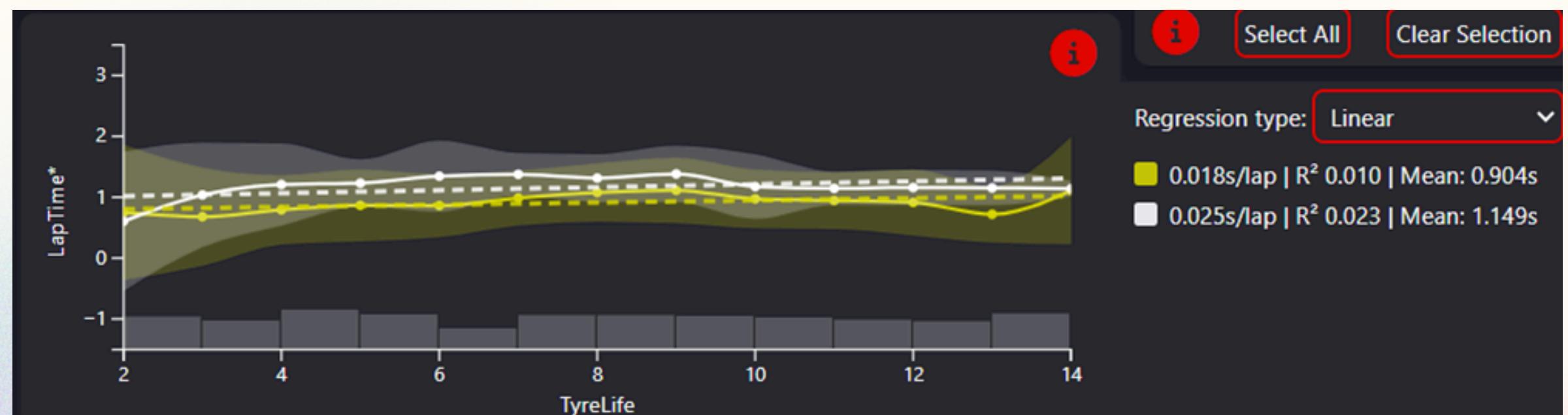
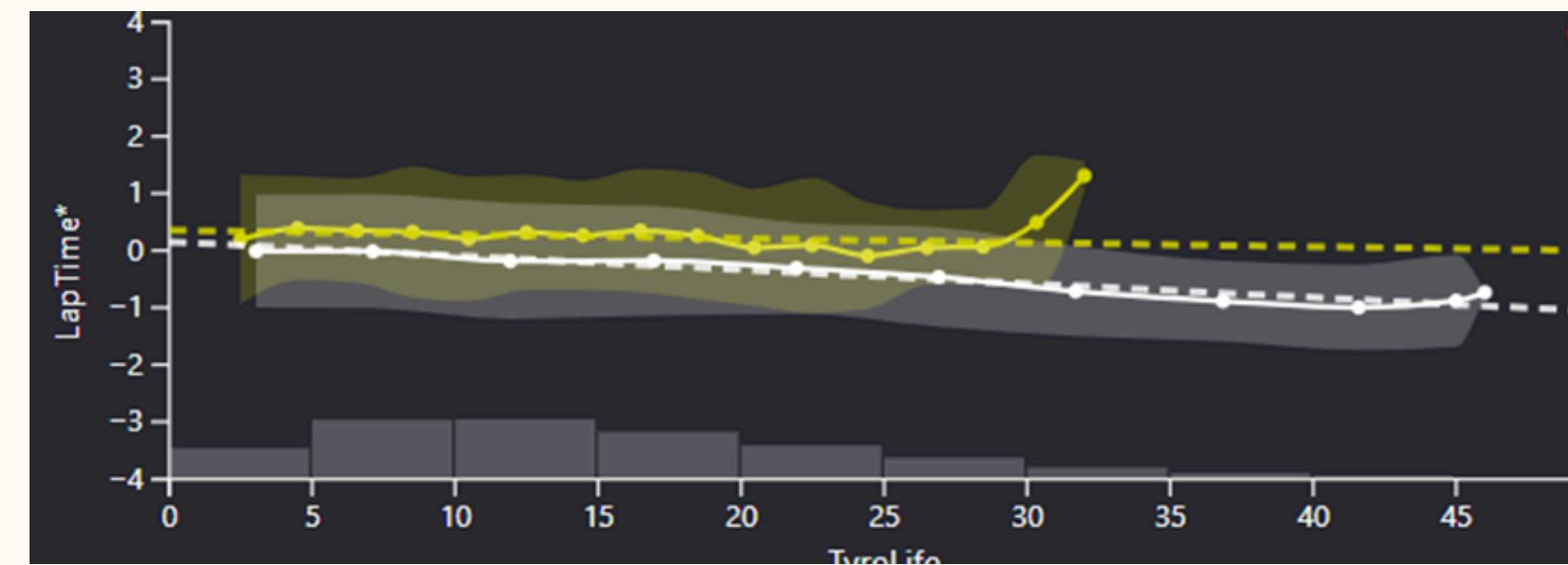
- Counterintuitive trend: lap times improve as tire life increases.
- Particularly visible on hard compound.
- Regression: average gain of 0.022s per lap, cumulative  $\approx -0.924s$ .
- Explanation: reduced fuel load > tire wear effect.



# System - Insights

## Hard vs. Medium Tires

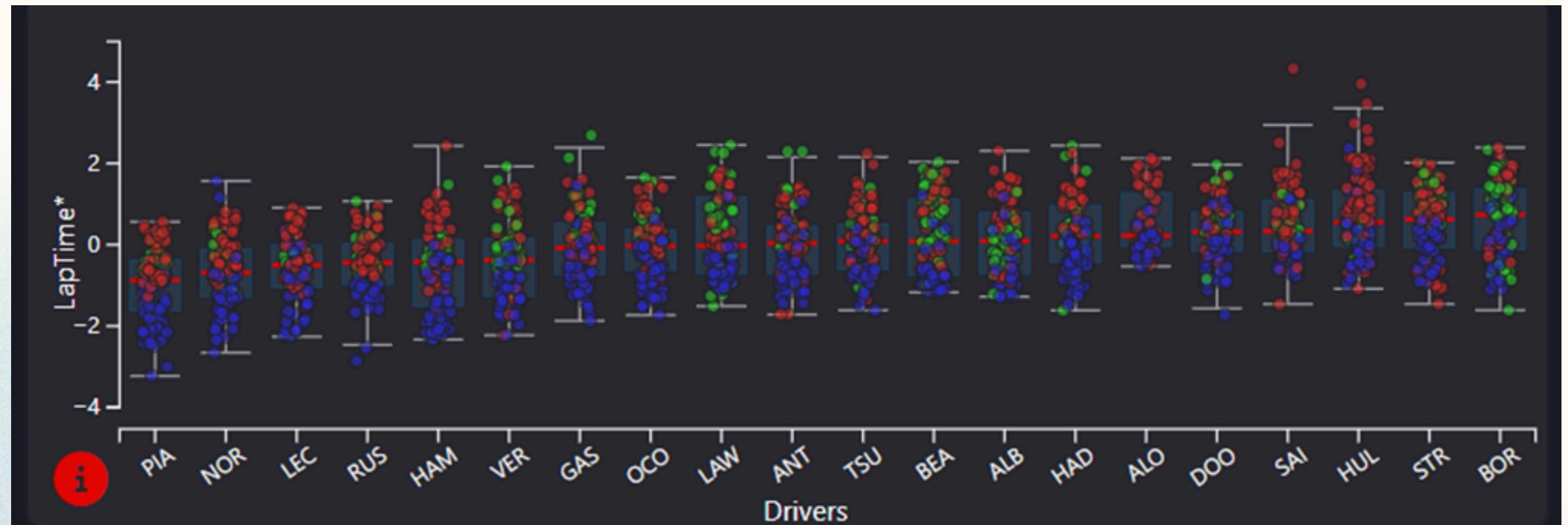
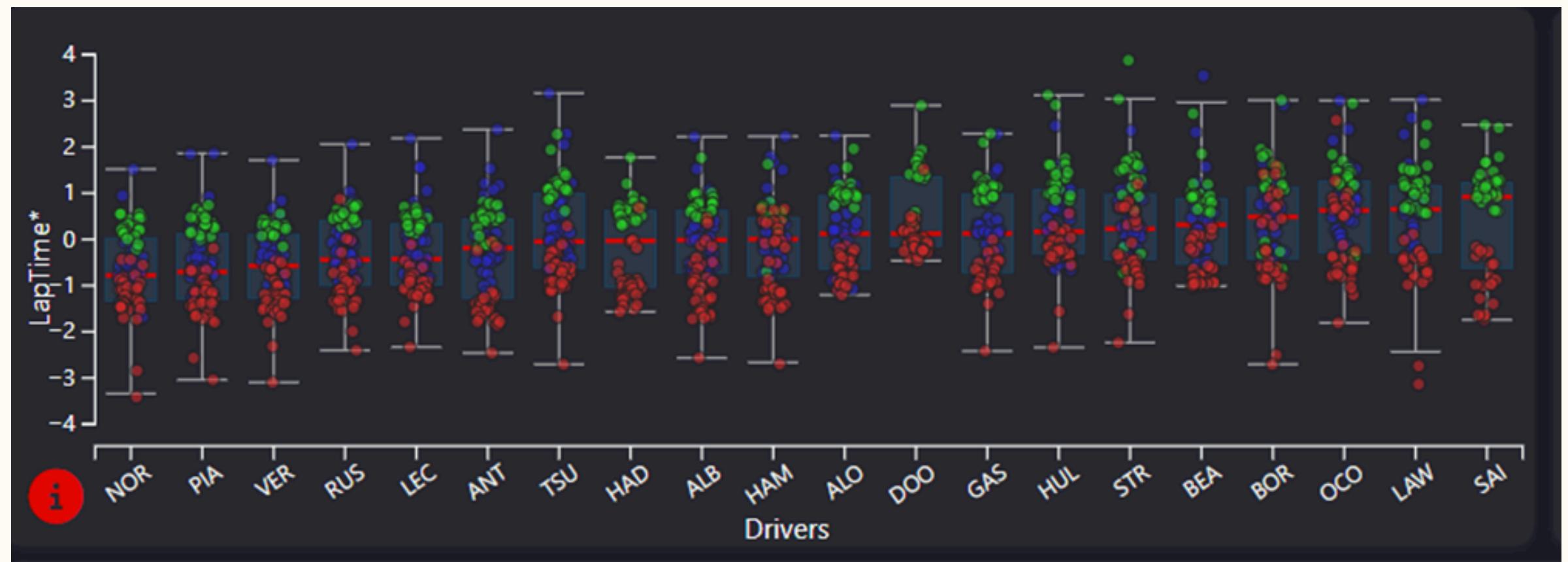
- Hard tires outperform mediums overall, with lower degradation.
- But: in first quarter of race → mediums faster.
- Maybe heavy fuel load penalizes hards or lose racing dynamics (dirty air, slipstream, battles).
- From second quarter onward → hards regain advantage.



# System - Insights

## Team Performance & Temperature Sensitivity

- Red Bull → stronger in colder conditions, struggles in heat.
- Ferrari → benefits from higher track temps, weaker in the cold.



# Bibliography

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- [1] M. Vincken, Visualisation of formula one racing results, 2016.
- [2] I. H. d. Hartog, Data to drive: Personalized visualization in formula one racing, 2022.
- [3] A. La Torre Castellort, F1 data analysis, 2025.
- [4] A. M. Prescott Delzell Patrick McCabe, Automation of data analysis in formula 1, 2019.