

# F1 Racer Efficiency

**Dataset Name:** Formula 1 World Championship (1950 - 2024)

**Dataset Link:** [https://www.kaggle.com/datasets/rohanrao/formula-1-world-championship-1950-2020?select=pit\\_stops.csv](https://www.kaggle.com/datasets/rohanrao/formula-1-world-championship-1950-2020?select=pit_stops.csv)

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## 1. Use Case Description

This project centers around developing a data-driven analytics platform that provides insights into the efficiency and skill of Formula 1 drivers. Using historical data from the Formula 1 World Championship spanning from 1950 to 2024, the platform will analyze individual drivers' performance metrics, including standings, lap times, pitstop efficiency, and qualifying results. The primary objective of this platform is to enable racing analysts, F1 enthusiasts, and potentially betting platforms to access detailed statistics and rankings related to a driver's performance, skills, and efficiencies over time.

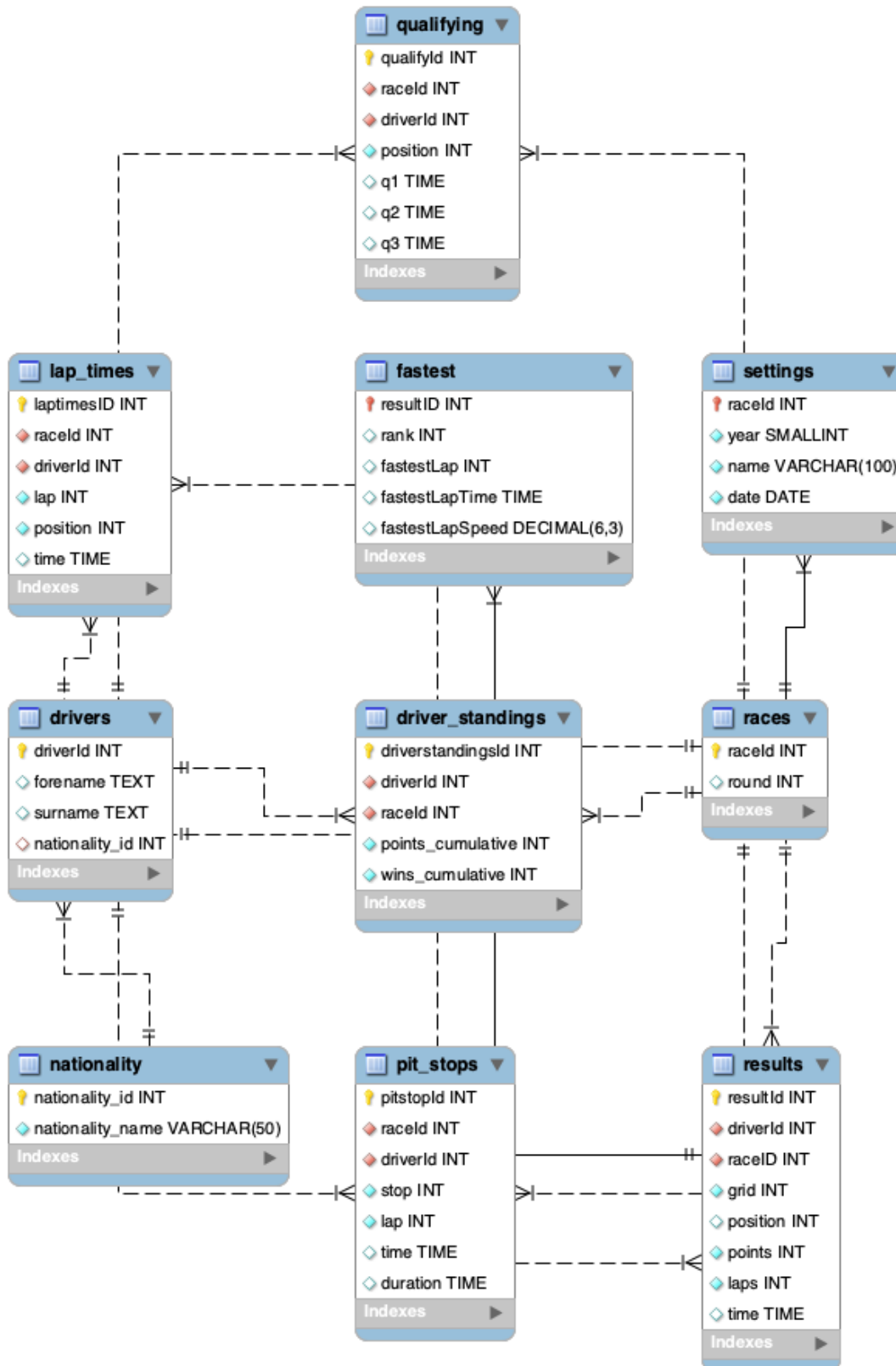
The platform will process and analyze data from the following tables: driver\_standings.csv, driversId.csv, raceId.csv, lap\_times.csv, pit\_stops.csv, qualifying.csv, and results.csv. These datasets contain critical information related to specific driver performance metrics that enable us to structure our platform. Users will view individual drivers and inspect detailed performance statistics, such as average lap times, pit stop efficiency, qualifying positions, and overall race results. The goal is to rank drivers based on individual performance metrics that reflect their consistency, speed, and strategic efficiency in races. This platform will aid enthusiasts and analysts in understanding driver performance trends and provide valuable data points that could be used for predictive insights, such as sports betting.

By focusing on core performance metrics and presenting them in a clear, user-friendly format, this platform provides a valuable tool for anyone looking to understand or analyze nuanced data points of F1 driver efficiency.

## 2. Relationship Rules

- Drivers have one cumulative standing for their careers
  - Each standing belongs to one driver
- Each driver has zero to many lap times for every race
  - Each race has zero to many lap times for every driver
- Each driver can have zero to many pit stops for every race
  - Each pit stop belongs to one driver
- Each driver has one to many results throughout a career
  - Each result belongs to one driver throughout a career
- Each driver has zero to many qualifying positions
  - Each qualifying position belongs to one driver
- Each driver has only one nationality
  - Each nationality can belong to many drivers
- Each race has many results
  - Each result belongs to one race
- One race has zero to many qualifying positions
  - Each qualifying position belongs to one race
- One race has many lap times
  - Each lap time belongs to one race
- One race has many pit stops
  - Each pit stop belongs to one race
- Each race occurs at one location and time
  - One location and time belongs to one race
- Each race awards points to drivers increasing their cumulative statistics
  - A driver's cumulative standing is influenced by one to many races
- Each result has a fastest lap
  - The fastest lap of each result belongs to one driver
- Each qualifying position has one time for each session
  - Each session time belongs to one qualifying position

### 3. Entity Relationship Diagram (ERD)



## 4. Data Exploration

Identify 3 key fields:

**Numeric:** fastestLapSpeed

**String:** surname

**Date/Time:** time

*Union between those fields*

	field	total_count	unique_count	min_value	max_value	average_value	sum_value
▶	fastestLapSpeed	8252	7724	89.540	257.320	204.1163303	1684367.958
	surname	147	144	Adams	Zonta	NULL	NULL
	time	589081	75774	00:00:55.404	00:53:24.155	NULL	NULL

Analysis:

There is a concerning number of NULL values (18,507) in both fastestLapSpeed and fastestLapTime. However, this is explained by the context of the dataset. These NULLs are primarily due to the age of the data; fastest lap data was not included until the 2004 F1 season. This also accounts for data limitations such as incomplete telemetry, recording errors, and situations like driver DNFs (Did Not Finish), where no fastest lap was recorded. For example, Michele Alboreto's entire F1 career lasted from 1981 to 1994, before the fastest data was included in our dataset. He participated in 215 total races and has 215 null values in fastestLapSpeed and fastestLapTime.

field	total_problematic	earliest_recorded_fastest	latest_recorded_fastest
fastestLapSpeed	18507		
▶ surname	0	▶ 2004-03-07	2024-12-08
time	0		

forename	surname	missing_speeds
Michele	Alboreto	215
Andrea	de Cesaris	214
Gerhard	Berger	210
Nelson	Piquet	207
Alain	Prost	202
Jean	Alesi	202
Michael	Schumacher	196
Nigel	Mansell	192
Rubens	Barrichello	183

field	total_not_nulls
fastestLapTime	8252
fastestLapSpeed	8252

According to our analysis of name data (surname and forename), there are no null values indicated by the total\_problematic column. Additionally, the time field fetched from lap\_times has no null values present in its dataset.

```

1      -- Numeric column fastestLapSpeed:
2 •    SELECT
3      'fastestLapSpeed' AS field,
4      COUNT(f.fastestLapSpeed) AS total_count,
5      COUNT(DISTINCT f.fastestLapSpeed) AS unique_count,
6      MIN(f.fastestLapSpeed) AS min_value,
7      MAX(f.fastestLapSpeed) AS max_value,
8      AVG(f.fastestLapSpeed) AS average_value,
9      SUM(f.fastestLapSpeed) AS sum_value
10     FROM results r
11     JOIN fastest f ON r.resultId = f.resultId
12     UNION
13
14     -- Union with String column surname:
15     SELECT
16     'surname' AS field,
17     COUNT(d.surname),
18     COUNT(DISTINCT d.surname),
19     MIN(d.surname),
20     MAX(d.surname),
21     NULL, NULL
22     FROM drivers d
23     UNION
24
25     -- Union with Date/Time column laptime:
26     SELECT
27     'time' AS field,
28     COUNT(l.time),
29     COUNT(DISTINCT l.time),
30     MIN(l.time),
31     MAX(l.time),
32     NULL, NULL
33     FROM lap_times l;

```

## 5. Data Analysis

### Analysis 1:

This view returns the number of First-Place finishes (aliased as total\_wins) that each country has, ordered by the total number of wins from highest to lowest.

```

1  CREATE VIEW nationality_wins AS
2  SELECT
3      n.nationality_name,
4      SUM(wins_per_driver) AS total_wins
5  FROM nationality n
6      JOIN drivers d
7      ON n.nationality_id = d.nationality_id
8      JOIN (
9          SELECT driverId,
10             COUNT(position) AS wins_per_driver
11          FROM results
12          WHERE position = 1
13          GROUP BY driverId
14      ) r ON d.driverId = r.driverId
15  GROUP BY n.nationality_name
16  ORDER BY total_wins DESC;
17
18 • SELECT *
19 FROM nationality_wins;

```

The Nationality's Total Wins Results:

	nationality_name	total_wins
	British	193
	German	176
	Brazilian	86
	French	53
	Finnish	42
	Spanish	32
	Italian	16
	Canadian	11
	Austrian	10
	Australian	9
	Colombian	7
	Belgian	3
	Polish	1

## Analysis 2:

This view shows the average lap speed for each driver who raced in the Malaysian Grand Prix on 3/25/2012. The average lap speeds are pulled from a CTE, which looks for results where the *raceId* is 860. The view compares the average lap speed with the finishing place of each F1 driver in race 860. The view shows that the fastest racers, via their average lap speed, are not necessarily the top-placing racers. It also shows how fast the racers who didn't actually finish the race were completing their laps on average, and what their final position was after their teams points were adjusted.

**Important Note:** The F1 Kaggle database is missing 100s of drivers in the driver table, but any given race only has about 24 drivers. Any analysis of data must be understood through this lens.

```

1  -- the average lap time for each individual driver during ONE raceID 860
2  • CREATE OR REPLACE VIEW avg_laps_race860 AS
3  WITH avg_laps AS (
4      SELECT
5          driverId,
6          raceId,
7          AVG(time) AS average_lap_time
8      FROM lap_times
9      WHERE raceId = 860
10     GROUP BY driverId, raceId
11 )
12
13 SELECT
14     s.name AS Race,
15     s.date AS Date,
16     CONCAT(d.forename, ' ', d.surname) AS Driver,
17     al.driverId,
18     CONCAT(ROUND(al.average_lap_time, 2), 's') AS Avg_Lap,
19     CASE
20         WHEN r.position IS NULL THEN 'Did Not Finish'
21         ELSE CAST(r.position AS CHAR)
22     END AS Results_,
23     r.grid AS Final_Standing
24 FROM avg_laps al
25 JOIN drivers d
26     ON al.driverId = d.driverId
27 JOIN settings s
28     ON al.raceId = s.raceId
29     LEFT JOIN results r
30         ON d.driverId = r.driverId
31         AND r.raceId = s.raceId
32 ORDER BY
33     CASE WHEN r.position IS NULL THEN 1 ELSE 0 END, -- If driver finished the race, list them first
34     al.average_lap_time; -- then order by lap speed to analyze MORE than just position
35
36 • SELECT * FROM avg_laps_race860;
37

```

	Race	Date	Driver	driverId	Avg_Lap	Results_	Final_Standing
	Malaysian Grand Prix	2012-03-25	Jenson Button	18	140.16s	1	2
	Malaysian Grand Prix	2012-03-25	Lewis Hamilton	1	140.24s	3	1
	Malaysian Grand Prix	2012-03-25	Fernando Alonso	4	140.54s	5	12
	Malaysian Grand Prix	2012-03-25	Sebastian Vettel	20	140.89s	2	6
	Malaysian Grand Prix	2012-03-25	Mark Webber	17	140.93s	4	5
	Malaysian Grand Prix	2012-03-25	Nico Rosberg	3	141.16s	12	7
	Malaysian Grand Prix	2012-03-25	Kimi Räikkönen	8	141.51s	7	17
	Malaysian Grand Prix	2012-03-25	Timo Glock	10	142.72s	14	20
	Malaysian Grand Prix	2012-03-25	Michael Schumacher	30	135.22s	Did Not Finish	4
	Malaysian Grand Prix	2012-03-25	Heikki Kovalainen	5	142.86s	Did Not Finish	18
	Malaysian Grand Prix	2012-03-25	Felipe Massa	13	143.23s	Did Not Finish	16

### Analysis 3:

This view returns a rank of Formula 1 drivers based on their average pit stop duration. It includes only those with 5 or more total stops so as to not skew the data. The



goal is to identify which drivers (and by extension, teams) had the most efficient pit stops and pit crews.

```

1 • CREATE VIEW pit_stop_efficiency AS
2   SELECT
3     CONCAT(d.forename, ' ', d.surname) AS Driver,
4     ROUND(AVG(p.duration), 2) AS avg_pit_time_seconds,
5     COUNT(*) AS total_stops
6   FROM pit_stops p
7   JOIN drivers d ON p.driverId = d.driverId
8   GROUP BY d.driverId
9   HAVING total_stops >= 5
10  ORDER BY avg_pit_time_seconds ASC;
11
12 • SELECT * FROM pit_stop_efficiency;

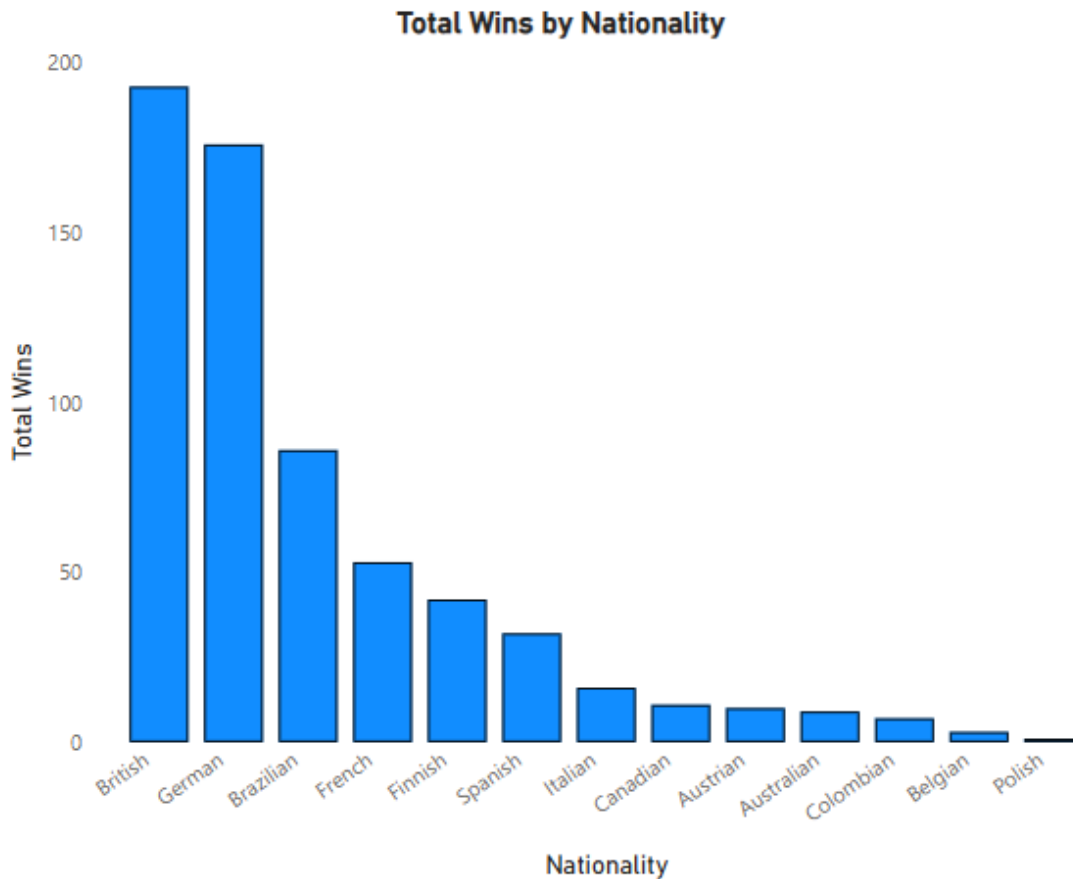
```

### Results:

	Driver	avg_pit_time_seconds	total_stops
▶	Mark Webber	22.43	142
	Michael Schumacher	22.54	90
	Nick Heidfeld	22.93	25
	Jenson Button	23.20	259
	Nico Rosberg	23.24	249
	Lewis Hamilton	23.47	557
	Adrian Sutil	23.49	121
	Felipe Massa	23.61	315
	Sebastian Vettel	23.67	463
	Timo Glock	23.74	75
	Fernando Alonso	23.81	474
	SÃ©bastien Buemi	24.02	41
	Kimi RÄ¤ikkÄ©nen	24.32	356
	Robert Kubica	24.43	42
	Heikki Kovalainen	24.61	99
	Rubens Barrichello	24.62	50
	Jarno Trulli	25.11	38
	Pedro de la Rosa	25.25	37
	Narain Karthikeyan	25.66	49
	Vitantonio Liuzzi	27.40	41

## 6. Key Findings

### Key Finding 1:



This graph showcases the results from the `nationality_wins` view. This reveals which countries have the highest and lowest number of Formula One championship wins. Britain and Germany are the top nations, with Brazil and France behind. Countries not pictured on this graph do not have a Formula One championship win in the database. Interestingly, the United States of America is not pictured on this graph, meaning they have no wins in this Kaggle database. Despite being one of the best nations for international sports, as shown by the Olympics, America struggles in Formula One racing in comparison to smaller countries with Gross Domestic Products that are tiny in

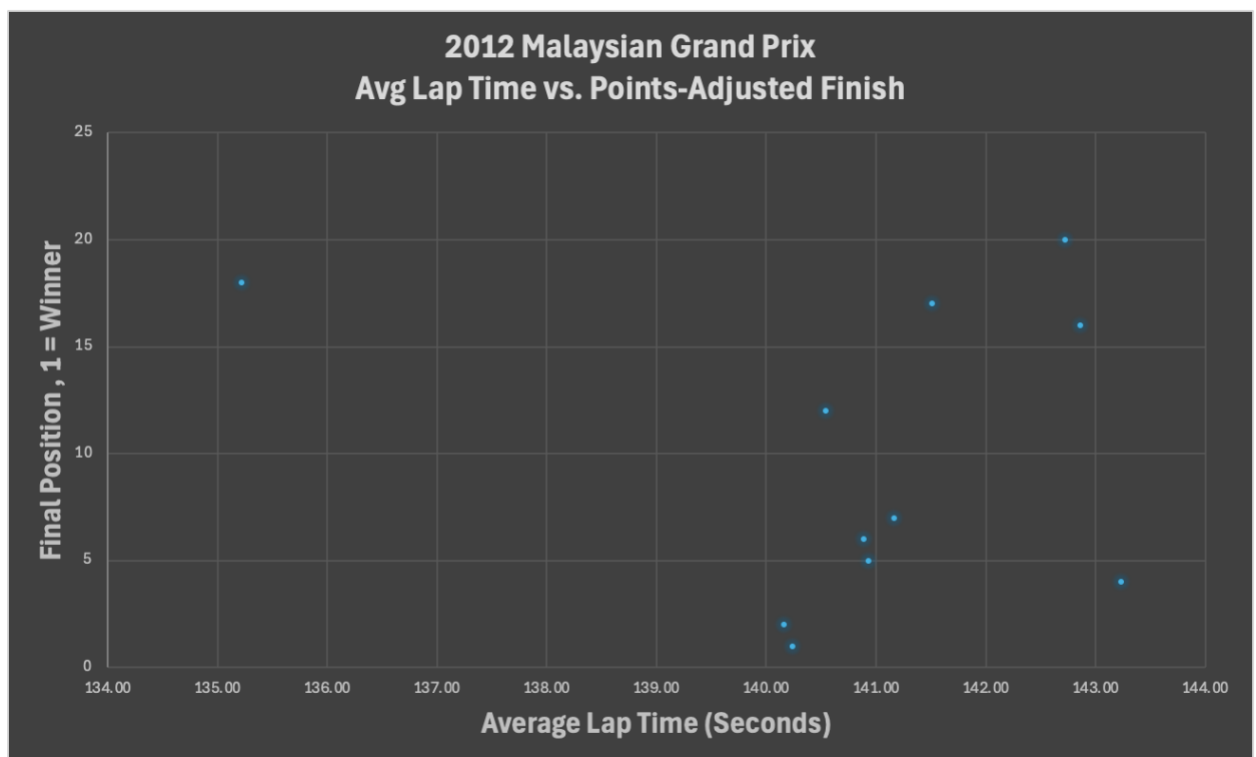
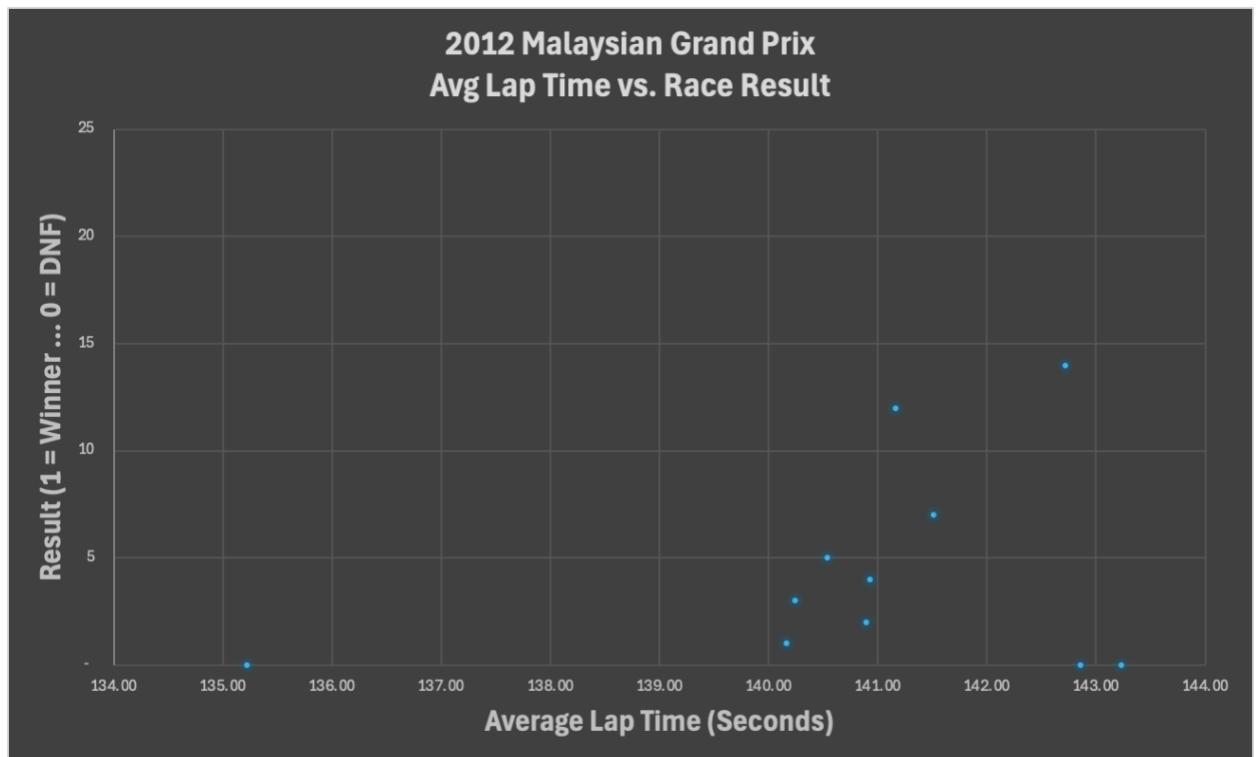
comparison. This is also surprising given the United States' interest in racing, just in the NASCAR format instead of F1.

### Key Finding 2:

The *Avg Lap Time VS Race Result* (Pre Points Adjustment) chart depicts the average lap time of each driver against which place they cross the finish line. This doesn't solely determine whether they win or lose because drivers still must go through an adjustment of "points" before their final time is calculated. For that reason, I've added an *Avg Lap Time VS Points-Adjusted Finish* chart.

From our *Race Result* chart, we can see that both the fastest driver, with an average lap time of 135.22 seconds, and the slowest driver, with an average lap time of 143.23 seconds, did not finish the race, with "0" place representing that they did not finish. To explain both of these, in our research, we found that there are many reasons why a driver could not finish a race. For example, sometimes drivers crash, but other times, drivers have engine trouble and choose to slow down to preserve their engine.

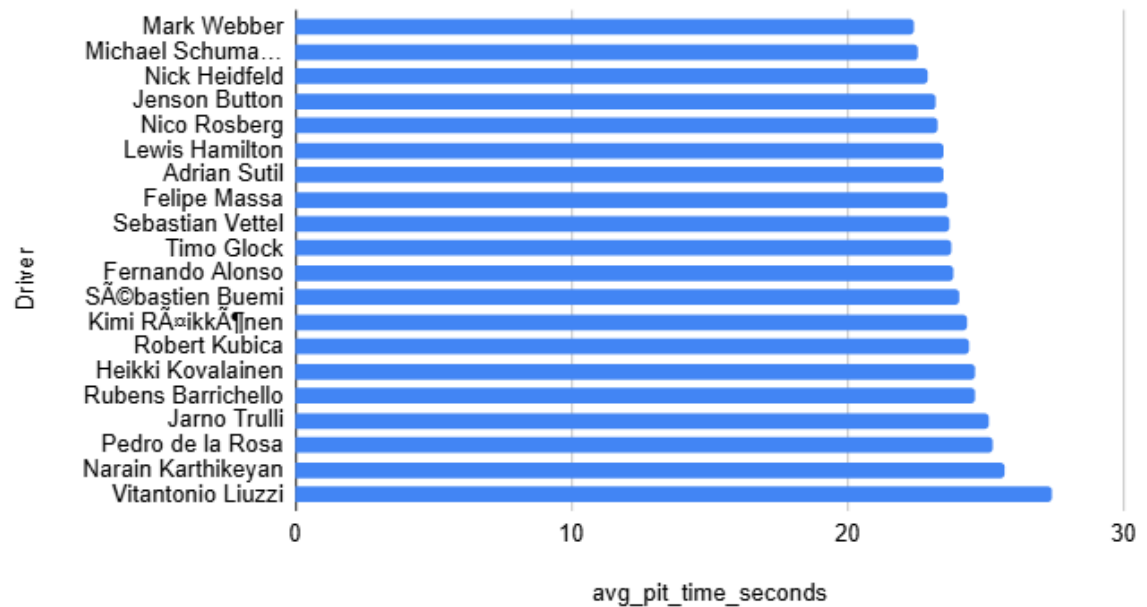
Visually, on our *Race Result* scatter plot, we can see that generally, as a driver's average lap time goes up, they come in closer to last place. After we factor in points and penalties, the negative trend is largely still in place, suggesting that it's still a good strategy to finish fast instead of driving cautiously slow. Lastly, outliers that did not finish the race still get a place in the final standings. One outlier placed in the top 5, which suggests that there is still strategy to be had, even though they didn't finish.



Key Finding 3:

The two charts that were shown outline the average duration of pit stops per driver against the sum of all the stops made by each driver. According to this data, Mark Webber benefits the most out of the drivers, with the fastest average pit stops at 22.43 seconds, followed by Michael Schumacher and Nick Heidfeld. It seems clear that these drivers had high-functioning pit crews. On the other end, Vitantonio Liuzzi and Narain Karthikeyan had the slowest average pit times above 25 seconds. This will likely yield negative results for the racers regarding their overall race positions. Surprisingly, some drivers maintained fast averages despite a high volume of pit stops. For instance, Lewis Hamilton and Sebastian Vettel each recorded well over 400 stops yet somehow managed to average below 24 seconds. The total stops graph also reveals the tendency of some other high-caliber drivers, such as Fernando Alonso, Kimi Räikkönen, and Jenson Button, to frequently go into the pits, perhaps due to age or particular racing strategies. In any event, the data would appear to demonstrate that as an athlete's workload increases, the performance consistency and speed during the pit stops become more refined.

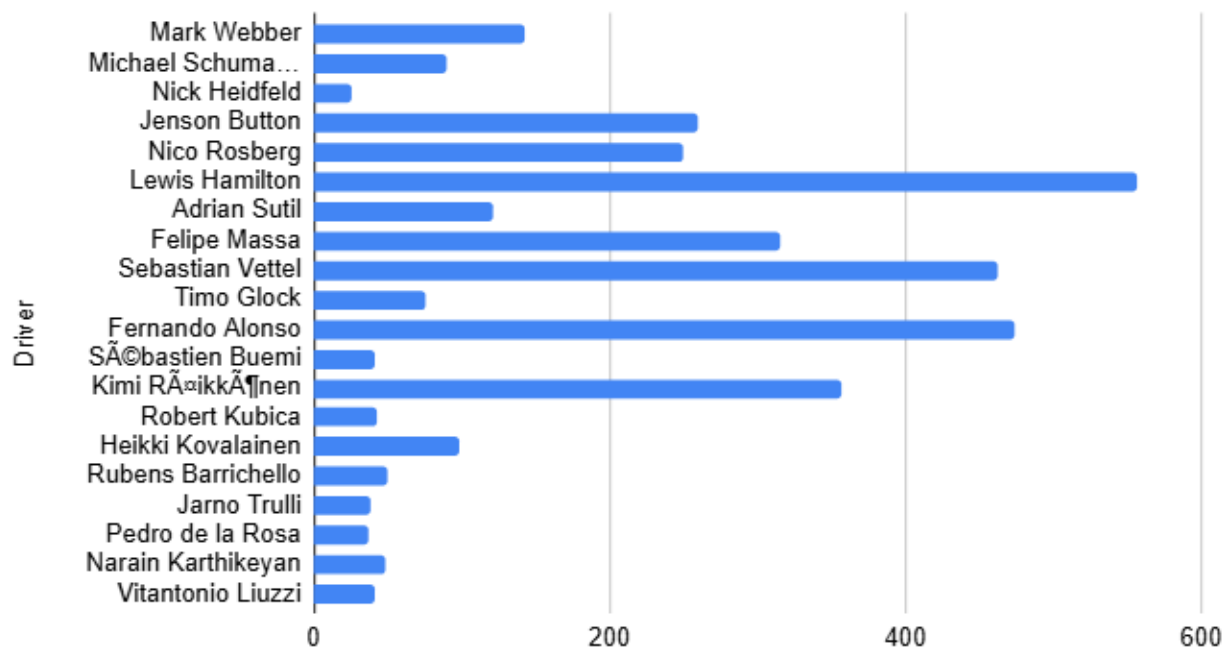
Avg Pit time in seconds per Driver



X Axis = The average time spent during a Pit Stop in seconds

Y Axis = Top 20 Drivers with regard to Pit Stop time average

Total Stops per driver



X Axis = Number of pit stops recorded by the data set

Y Axis = Top 20 Drivers with regard to Pit Stop time average

## 7.1 Data Dictionary

Table: driver\_standings

Attribute	Data Type	Key	Description
driverstandingsId	INT	PK	Unique identifier for each driver standings record. Used to track a driver's cumulative performance over the season.
driverId	INT	FK referencing drivers(driverId)	Identifier of the driver whose standings are being recorded.
raceId	INT	FK referencing races(raceId)	Identifier of the race after which the standings are updated.
points_cumulative	INT		Total championship points the driver has accumulated up to the current race.
wins_cumulative	INT		Total number of race wins the driver has achieved in the season.

Table: drivers

Attribute	Data Type	Key	Description
driverId	INT	PK	Unique identifier for each driver.

forename	TEXT		Driver's first name.
surname	TEXT		Driver's last name.
nationality_id	INT	FK referencing nationality(nationality_id)	Identifier for the driver's nationality. Important for team and fan identities in F1.

Table: fastest

Attribute	Data Type	Key	Description
resultID	INT	PK, FK referencing results(resultId)	Unique identifier for the fastest lap record. Also links to the overall race result. Cascading updates/deletes ensure referential integrity.
rank	INT		Rank of the lap time among competitors (e.g., fastest, second fastest).
fastestLap	INT		The lap number on which the fastest lap was set.
fastestLapTime	TIME		The recorded fastest lap time during the race.
fastestLapSpeed	DECIMAL(6,3)		The average speed (typically in km/h) achieved on the fastest lap.



Table: lap\_times

Attribute	Data Type	Key	Description
laptimesID	INT	PK (AUTO_INCREMENT)	Unique identifier for each lap time record.
racelId	INT	FK referencing races(racelId)	Identifier of the race during which the lap was recorded.
driverId	INT	FK referencing drivers(driverId)	Identifier of the driver who completed the lap.
lap	INT		The lap number within the race.
position	INT		The driver's position at the end of the specific lap.
time	TIME(3)		The lap time achieved by the driver, including millisecond precision.

Table: nationality

Attribute	Data Type	Key	Description
nationality_id	INT	PK (AUTO_INCREMENT)	Unique identifier for each nationality.
nationality_name	VARCHAR(50)	Unique	Name of the nationality (e.g., British,

			Italian, German).
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Table: pit\_stops

Attribute	Data Type	Key	Description
pitstopId	INT	PK (AUTO_INCREMENT)	Unique identifier for each pit stop record.
raceId	INT	FK referencing races(raceId)	Identifier of the race in which the pit stop occurred.
driverId	INT	FK referencing drivers(driverId)	Identifier of the driver making the pit stop.
stop	INT		Sequential number of the pit stop during the race (e.g., 1 for the first stop, 2 for the second).
lap	INT		The lap number during which the pit stop took place.
time	TIME		The clock time at which the pit stop was initiated. In F1, this can indicate race strategy and timing.

duration	TIME(3)		The duration of the pit stop, measured with millisecond precision, reflecting how quickly the stop was completed.
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Table: qualifying

Attribute	Data Type	Key	Description
qualifyId	INT	PK	Unique identifier for each qualifying session record.
raceId	INT	FK referencing races(raceId)	Identifier of the race for which the qualifying session is held.
driverId	INT	FK referencing drivers(driverId)	Identifier of the driver participating in the qualifying session.
position	INT		The grid position earned by the driver based on their qualifying performance.
q1	TIME(3)		Lap time achieved during the first qualifying session (Q1).
q2	TIME(3)		Lap time achieved during the second qualifying session (Q2), if applicable.

q3	TIME(3)		Lap time achieved during the third qualifying session (Q3), if applicable.
----	---------	--	--

Table: races

Attribute	Data Type	Key	Description
raceId	INT	PK	Unique identifier for each race.
round	INT		The round number of the race within the current F1 championship season. Often indicates sequence in the season.

Table: results

Attribute	Data Type	Key	Description
resultId	INT	PK	Unique identifier for each race result record.
driverId	INT	FK referencing drivers(driverId)	Identifier of the driver whose result is being recorded.
raceID	INT	FK referencing races(raceID)	Identifier of the race corresponding to the result record. Note: Ensure consistency in column naming (raceId vs. raceID).
grid	INT	—	The starting grid position of the driver at the beginning of the race.

position	INT	–	The final finishing position of the driver at the end of the race.
points	INT	–	Championship points awarded to the driver based on their finishing position.
laps	INT	–	The total number of laps the driver completed during the race.
time	TIME	–	The overall race time or time difference relative to the winner (if applicable).

Table: settings

Attribute	Data Type	Key	Description
raceld	INT	PK, FK referencing races(raceld)	Unique identifier for the race settings record; ties settings directly to the race.
year	SMALLINT	–	The calendar year in which the race took place.
name	VARCHAR(100)	–	The official name of the race (e.g., “British Grand Prix”).
date	DATE	–	The date on which the race was held.

## 7.2 Screenshots of All Tables and Relationships

### Join Code:

```

1  -- drivers + nationality
2  • SELECT d.driverId, d.forename, d.surname, n.nationality_name
3  FROM drivers d
4  JOIN nationality n ON d.nationality_id = n.nationality_id;
5
6  -- drivers + driver_standings
7  • SELECT d.driverId, d.forename, d.surname, ds.points_cumulative, ds.wins_cumulative
8  FROM drivers d
9  JOIN driver_standings ds ON d.driverId = ds.driverId;
10
11 -- results + drivers + races
12 • SELECT r.resultId, d.forename, d.surname, rs.round AS round, r.position, r.points
13 FROM results r
14 JOIN drivers d ON r.driverId = d.driverId
15 JOIN races rs ON r.raceId = rs.raceId;
16
17 -- lap_times + drivers + races
18 • SELECT d.forename, d.surname, l.raceId, l.lap, l.time
19 FROM lap_times l
20 JOIN drivers d ON l.driverId = d.driverId
21 JOIN races r ON l.raceId = r.raceId;
22
23 -- pit_stops + drivers + races
24 • SELECT d.forename, d.surname, r.round AS round, p.lap, p.duration
25 FROM pit_stops p
26 JOIN drivers d ON p.driverId = d.driverId
27 JOIN races r ON p.raceId = r.raceId;
28
29 -- qualifying + drivers + races
30 • SELECT d.forename, d.surname, r.round AS round, q.position
31 FROM qualifying q
32 JOIN drivers d ON q.driverId = d.driverId
33 JOIN races r ON q.raceId = r.raceId;
34
35 -- results + fastest + drivers
36 • SELECT r.resultId, d.forename, d.surname, f.fastestLapTime, f.fastestLapSpeed
37 FROM results r
38 JOIN fastest f ON r.resultId = f.resultId
39 JOIN drivers d ON r.driverId = d.driverId;

```

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Table Selects:

```

1 • USE f1;
2
3   -- Select drivers
4 • SELECT * FROM drivers LIMIT 10;
5
6   -- Select nationality
7 • SELECT * FROM nationality LIMIT 10;
8
9   -- Select races
10 • SELECT * FROM races LIMIT 10;
11
12  -- Select settings
13 • SELECT * FROM settings LIMIT 10;
14
15  -- Select driver standings
16 • SELECT * FROM driver_standings LIMIT 10;
17
18  -- Select results
19 • SELECT * FROM results LIMIT 10;
20
21  -- Select lap times
22 • SELECT * FROM lap_times LIMIT 10;
23
24  -- Select pit stops
25 • SELECT * FROM pit_stops LIMIT 10;
26
27  -- Select fastest lap info
28 • SELECT * FROM fastest LIMIT 10;
29
30  -- Select qualifying
31 • SELECT * FROM qualifying LIMIT 10;

```

Drivers:

	driverId	forename	surname	nationality_id
▶	1	Lewis	Hamilton	1
	2	Nick	Heidfeld	2
	3	Nico	Rosberg	2
	4	Fernando	Alonso	3
	5	Heikki	Kovalainen	4
	6	Kazuki	Nakajima	5
	7	Sébastien	Bourdais	6
	8	Kimi	Räikkönen	4
	9	Robert	Kubica	7
	10	Timo	Glock	2
*	NULL	NULL	NULL	NULL

DriverStandings:

Result Grid					
Filter Rows:					
	driverstandingsId	driverId	raceId	points_cumulative	wins_cumulative
▶	1	1	18	10	1
	2	2	18	8	0
	3	3	18	6	0
	4	4	18	5	0
	5	5	18	4	0
	6	6	18	3	0
	7	7	18	2	0
	8	8	18	1	0
	9	1	19	14	1
	10	2	19	11	0
*	NULL	NULL	NULL	NULL	NULL

Laptime:

	laptimesID	raceId	driverId	lap	position	time
▶	1	841	20	1	1	00:01:38.109
	2	841	20	2	1	00:01:33.006
	3	841	20	3	1	00:01:32.713
	4	841	20	4	1	00:01:32.803
	5	841	20	5	1	00:01:32.342
	6	841	20	6	1	00:01:32.605
	7	841	20	7	1	00:01:32.502
	8	841	20	8	1	00:01:32.537
	9	841	20	9	1	00:01:33.240
	10	841	20	10	1	00:01:32.572
*	NULL	NULL	NULL	NULL	NULL	NULL

Nationality:

Result Grid	
Filter Rows:	
nationality_id	nationality_name
▶	12 American
	21 Argentine
	10 Australian
	11 Austrian
	25 Belgian
	8 Brazilian
	1 British
	16 Canadian
	14 Colombian
	22 Czech
*	NULL

Fastest:



	resultId	rank	fastestLap	fastestLapTime	fastestLapSpeed
▶	1	2	39	01:27:00	218.300
	2	3	41	01:27:01	217.586
	3	5	41	01:28:00	216.719
	4	7	58	01:28:01	215.464
	5	1	43	01:27:00	218.385
	6	14	50	01:29:01	212.974
	7	8	54	01:29:01	213.224
	8	4	20	01:27:01	217.180
	9	9	15	01:28:01	215.100
	10	13	23	01:29:01	213.166
*	NULL	NULL	NULL	NULL	NULL

### PitStops:

	pitstopId	raceId	driverId	stop	lap	time	duration
▶	1	841	153	1	1	17:05:23	00:00:26.898
	2	841	30	1	1	17:05:52	00:00:25.021
	3	841	17	1	11	17:20:48	00:00:23.426
	4	841	4	1	12	17:22:34	00:00:23.251
	5	841	13	1	13	17:24:10	00:00:23.842
	6	841	22	1	13	17:24:29	00:00:23.643
	7	841	20	1	14	17:25:17	00:00:22.603
	8	841	814	1	14	17:26:03	00:00:24.863
	9	841	816	1	14	17:26:50	00:00:25.259
	10	841	67	1	15	17:27:34	00:00:25.342
*	NULL	NULL	NULL	NULL	NULL	NULL	NULL

### Qualifying:

	qualifyId	raceId	driverId	position	q1	q2	q3
▶	1	18	1	1	00:01:26.572	00:01:25.187	00:01:26.714
	2	18	9	2	00:01:26.103	00:01:25.315	00:01:26.869
	3	18	5	3	00:01:25.664	00:01:25.452	00:01:27.079
	4	18	13	4	00:01:25.994	00:01:25.691	00:01:27.178
	5	18	2	5	00:01:25.960	00:01:25.518	00:01:27.236
	6	18	15	6	00:01:26.427	00:01:26.101	00:01:28.527
	7	18	3	7	00:01:26.295	00:01:26.059	00:01:28.687
	8	18	14	8	00:01:26.381	00:01:26.063	00:01:29.041
	9	18	10	9	00:01:26.919	00:01:26.164	00:01:29.593
	10	18	20	10	00:01:26.702	00:01:25.842	NULL
*	NULL	NULL	NULL	NULL	NULL	NULL	NULL



### Races:

Result Grid		
	raceId	round
▶	1	1
	2	2
	3	3
	4	4
	5	5
	6	6
	7	7
	8	8
	9	9
	10	10
*	NULL	NULL

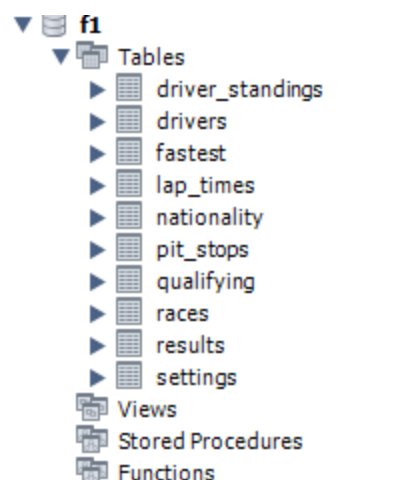
Results:

	resultId	driverId	raceID	grid	position	points	laps	time
▶	1	1	18	1	1	10	58	01:34:51
	2	2	18	5	2	8	58	NULL
	3	3	18	7	3	6	58	NULL
	4	4	18	11	4	5	58	NULL
	5	5	18	3	5	4	58	NULL
	6	6	18	13	6	3	57	NULL
	7	7	18	17	7	2	55	NULL
	8	8	18	15	8	1	53	NULL
	9	9	18	2	NULL	0	47	NULL
	10	10	18	18	NULL	0	43	NULL

Settings:

Result Grid				Filter Rows:	<input type="text"/>	Ed
	raceId	year	name	date		
▶	1	2009	Australian Grand Prix	2009-03-29		
	2	2009	Malaysian Grand Prix	2009-04-05		
	3	2009	Chinese Grand Prix	2009-04-19		
	4	2009	Bahrain Grand Prix	2009-04-26		
	5	2009	Spanish Grand Prix	2009-05-10		
	6	2009	Monaco Grand Prix	2009-05-24		
	7	2009	Turkish Grand Prix	2009-06-07		
	8	2009	British Grand Prix	2009-06-21		
	9	2009	German Grand Prix	2009-07-12		
	10	2009	Hungarian Grand Prix	2009-07-26		

Tables:



Join between Driver and LapTime:

	forename	surname	raceId	lap	time
▶	Sebastian	Vettel	841	1	00:01:38.109
	Sebastian	Vettel	841	2	00:01:33.006
	Sebastian	Vettel	841	3	00:01:32.713
	Sebastian	Vettel	841	4	00:01:32.803
	Sebastian	Vettel	841	5	00:01:32.342
	Sebastian	Vettel	841	6	00:01:32.605
	Sebastian	Vettel	841	7	00:01:32.502
	Sebastian	Vettel	841	8	00:01:32.537
	Sebastian	Vettel	841	9	00:01:33.240
	Sebastian	Vettel	841	10	00:01:32.572
	Sebastian	Vettel	841	11	00:01:32.669
	Sebastian	Vettel	841	12	00:01:32.902
	Sebastian	Vettel	841	13	00:01:33.698
	Sebastian	Vettel	841	14	00:01:52.075
	Sebastian	Vettel	841	15	00:01:38.385
	Sebastian	Vettel	841	16	00:01:31.548
	Sebastian	Vettel	841	17	00:01:30.800
	Sebastian	Vettel	841	18	00:01:31.810
	Sebastian	Vettel	841	19	00:01:31.018
	Sebastian	Vettel	841	20	00:01:31.055
	Sebastian	Vettel	841	21	00:01:31.288
	Sebastian	Vettel	841	22	00:01:31.084
	Sebastian	Vettel	841	23	00:01:30.075

Join between Driver and Races:

	driverId	forename	surname	points_cumulative	wins_cumulative
▶	1	Lewis	Hamilton	10	1
	2	Nick	Heidfeld	8	0
	3	Nico	Rosberg	6	0
	4	Fernando	Alonso	5	0
	5	Heikki	Kovalainen	4	0
	6	Kazuki	Nakajima	3	0
	7	SÃ©bastien	Bourdais	2	0
	8	Kimi	RÃ¤ikkÃ¶nen	1	0
	1	Lewis	Hamilton	14	1
	2	Nick	Heidfeld	11	0
	3	Nico	Rosberg	6	0
	4	Fernando	Alonso	6	0
	5	Heikki	Kovalainen	10	0
	6	Kazuki	Nakajima	3	0
	7	SÃ©bastien	Bourdais	2	0
	8	Kimi	RÃ¤ikkÃ¶nen	11	1
	9	Robert	Kubica	8	0
	15	Jarno	Trulli	5	0
	17	Mark	Webber	2	0
	14	David	Coulthard	0	0
	18	Jenson	Button	0	0
	12	Nelson	Piquet Jr.	0	0

Join between Driver and Nationality:

	driverId	forename	surname	nationality_name
▶	26	Scott	Speed	American
	121	Michael	Andretti	American
	60	GastÃ³n	Mazzacane	Argentine
	74	Esteban	Tuero	Argentine
	82	Norberto	Fontana	Argentine
	17	Mark	Webber	Australian
	101	David	Brabham	Australian
	25	Alexander	Wurz	Austrian
	32	Christian	Klien	Austrian
	40	Patrick	Friesacher	Austrian
	77	Gerhard	Berger	Austrian
	91	Karl	Wendlinger	Austrian
	107	Roland	Ratzenber...	Austrian
	92	Bertrand	Gachot	Belgian
	113	Philippe	Adams	Belgian
	123	Thierry	Boutsen	Belgian
	128	Eric	van de Poele	Belgian
	12	Nelson	Piquet Jr.	Brazilian
	13	Felipe	Massa	Brazilian
	22	Rubens	Barrichello	Brazilian
	41	Ricardo	Zonta	Brazilian
	42	AntÃ³nio	Pizzonia	Brazilian
	43	Giuliano	Barbieri	Italian

## Join between Results and Fastest:

	resultId	forename	surname	fastestLapTime	fastestLapSpeed
►	1	Lewis	Hamilton	01:27:00	218.300
	2	Nick	Heidfeld	01:27:01	217.586
	3	Nico	Rosberg	01:28:00	216.719
	4	Fernando	Alonso	01:28:01	215.464
	5	Heikki	Kovalainen	01:27:00	218.385
	6	Kazuki	Nakajima	01:29:01	212.974
	7	SÃ©bastien	Bourdais	01:29:01	213.224
	8	Kimi	RÃ¤ikkÃ¶nen	01:27:01	217.180
	9	Robert	Kubica	01:28:01	215.100
	10	Timo	Glock	01:29:01	213.166
	11	Takuma	Sato	01:30:01	210.038
	12	Nelson	Piquet Jr.	01:31:00	208.907
	13	Felipe	Massa	01:28:00	216.510
	14	David	Coulthard	01:29:01	213.300
	15	Jarno	Trulli	01:29:00	213.758

## Join between Driver, Races and PitStops:

	forename	surname	round	lap	duration
►	Michael	Schumacher	2	1	00:00:25.021
	Mark	Webber	2	11	00:00:23.426
	Fernando	Alonso	2	12	00:00:23.251
	Felipe	Massa	2	13	00:00:23.842
	Rubens	Barrichello	2	13	00:00:23.643
	Sebastian	Vettel	2	14	00:00:22.603
	SÃ©bastien	Buemi	2	15	00:00:25.342
	Nick	Heidfeld	2	15	00:00:22.994
	Lewis	Hamilton	2	16	00:00:23.227
	Nico	Rosberg	2	16	00:00:23.716
	Adrian	Sutil	2	16	00:00:25.978
	Jarno	Trulli	2	16	00:00:24.899
	Jenson	Button	2	17	00:00:16.867
	Heikki	Kovalainen	2	17	00:00:24.865
	Michael	Schumacher	2	17	00:00:23.988
	Timo	Glock	2	18	00:00:23.792
	Jenson	Button	2	19	00:00:23.303
	Rubens	Barrichello	2	23	00:00:37.856
	Mark	Webber	2	26	00:00:22.520
	Fernando	Alonso	2	27	00:00:24.733
	Rubens	Barrichello	2	28	00:00:16.892
	SÃ©bastien	Buemi	2	29	00:00:23.100

Join between Driver, Races and Qualifying:

	forename	surname	round	position
►	Lewis	Hamilton	1	1
	Robert	Kubica	1	2
	Heikki	Kovalainen	1	3
	Felipe	Massa	1	4
	Nick	Heidfeld	1	5
	Jarno	Trulli	1	6
	Nico	Rosberg	1	7
	David	Coulthard	1	8
	Timo	Glock	1	9
	Sebastian	Vettel	1	10
	Rubens	Barrichello	1	11
	Fernando	Alonso	1	12
	Jenson	Button	1	13
	Kazuki	Nakajima	1	14
	Mark	Webber	1	15
	Kimi	Räikkönen	1	16
	Giancarlo	Fisichella	1	17
	Sébastien	Bourdais	1	18
	Adrian	Sutil	1	19
	Takuma	Sato	1	20
	Nelson	Piquet Jr.	1	21
	Anthony	Davidson	1	22
	Felipe	Massa	2	1

Join between Driver, Races and Results:

	resultId	forename	surname	round	position	points
►	1	Lewis	Hamilton	1	1	10
	2	Nick	Heidfeld	1	2	8
	3	Nico	Rosberg	1	3	6
	4	Fernando	Alonso	1	4	5
	5	Heikki	Kovalainen	1	5	4
	6	Kazuki	Nakajima	1	6	3
	7	Sébastien	Bourdais	1	7	2
	8	Kimi	Räikkönen	1	8	1
	9	Robert	Kubica	1	NULL	0
	10	Timo	Glock	1	NULL	0
	11	Takuma	Sato	1	NULL	0
	12	Nelson	Piquet Jr.	1	NULL	0
	13	Felipe	Massa	1	NULL	0
	14	David	Coulthard	1	NULL	0
	15	Jarno	Trulli	1	NULL	0
	16	Adrian	Sutil	1	NULL	0
	17	Mark	Webber	1	NULL	0
	18	Jenson	Button	1	NULL	0
	19	Anthony	Davidson	1	NULL	0
	20	Sebastian	Vettel	1	NULL	0
	21	Giancarlo	Fisichella	1	NULL	0
	22	Rubens	Barrichello	1	NULL	0
	23	Felipe	Massa	2	1	10

## 7.3 Data Modification

### Insert Data:

We are inserting a new Grand Prix into the races and settings table. It is necessary for both tables to be updated as they are related to each other, and the *setting* table's primary key is a foreign key in the races table.

Failed Attempt: Error Code 1364 due to inserting the data in an incorrect order

Output			
Action Output			
#	Time	Action	Message
29	14:02:57	SELECT * FROM settings LIMIT 0, 1000	1000 row(s) returned
30	14:46:40	INSERT INTO settings (year, name, date) VALUES (2025, 'Australian Grand Prix', '2025-03-16')	Error Code: 1364, Field 'raceId' doesn't have a default value
31	14:49:21	INSERT INTO settings (year, name, date) VALUES (2025, 'Australian Grand Prix', '2025-03-16')	Error Code: 1364, Field 'raceId' doesn't have a default value

Successful Attempt: Inserted the raceId and round into values first so I had a raceId value to insert into settings

```

14 • INSERT INTO races (raceId, round)
15   VALUES (1145, 1);
16
17 • INSERT INTO settings (raceId, year, name, date)
18   VALUES (1145, 2025, 'Australian Grand Prix', '2025-03-16');
19
20 • SELECT * FROM settings
21   LIMIT 10000;

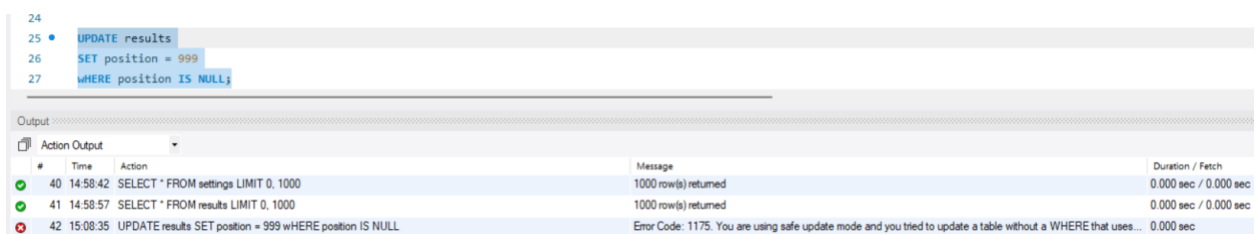
```

Result Grid				
Filter Rows: <input type="text"/>				
	raceId	year	name	date
▶	1145	2025	Australian Grand Prix	2025-03-16
	1102	2024	Bahrain Grand Prix	2024-03-02
	1103	2024	Saudi Arabian Grand...	2024-03-09
	1104	2024	Australian Grand Prix	2024-03-24
	1105	2024	Japanese Grand Prix	2024-04-07
	1106	2024	Chinese Grand Prix	2024-04-21

### Update data:

We updated the data by setting null values in the position column of the results table to 999. This makes the viewer aware that this was an incomplete time and position, while not being null, to avoid any issues. However, they must be made aware that 999 represents null for this column.

Failed Attempt: Error Code 1175. Safe mode prevents updating without a where clause using a primary key.



The screenshot shows a SQL editor with three lines of code: `UPDATE results`, `SET position = 999`, and `WHERE position IS NULL;`. Below the editor is an 'Output' pane with a table of execution results.

#	Time	Action	Message	Duration / Fetch
40	14:58:42	SELECT * FROM settings LIMIT 0, 1000	1000 row(s) returned	0.000 sec / 0.000 sec
41	14:58:57	SELECT * FROM results LIMIT 0, 1000	1000 row(s) returned	0.000 sec / 0.000 sec
42	15:08:35	UPDATE results SET position = 999 WHERE position IS NULL	Error Code: 1175. You are using safe update mode and you tried to update a table without a WHERE that uses...	0.000 sec




Successful Attempt: Disabled safe mode temporarily to edit the data, and then turned safe mode back on.



```

24
25 • SET SQL_SAFE_UPDATES = 0;
26
27 • UPDATE results
28   SET position = 999
29   WHERE position IS NULL;
30
31 • SET SQL_SAFE_UPDATES = 1;
32
33 • SELECT * FROM results;

```

Result Grid								
Filter Rows: <input type="text"/>								
Edit:   								
Export/Import								
	resultId	driverId	raceID	grid	position	points	laps	time
▶	9	9	18	2	999	0	47	NULL
	10	10	18	18	999	0	43	NULL
	11	11	18	19	999	0	32	NULL
	12	12	18	20	999	0	30	NULL
	13	13	18	4	999	0	29	NULL
	14	14	18	8	999	0	25	NULL
	15	15	18	1	999	0	24	NULL

### Delete data:

Deleting rows in the fastest table that have null values for rank, etc. This is due to this statistic not being tracked until 1995.

Failed Attempt: Error Code 1175. Safe mode prevents updating without a where clause using a primary key. Same problem I ran into during the updating process.

3 • DELETE FROM fastest

4 WHERE `rank` IS NULL;

5

6 • SELECT \* FROM fastest;

Output

Action Output

#	Time	Action	Message
✓ 16	13:17:12	SELECT * FROM fastest LIMIT 0, 1000	1000 row(s) returned
✓ 17	13:20:49	SELECT * FROM qualifying LIMIT 0, 1000	1000 row(s) returned
✓ 18	13:22:58	SELECT * FROM results LIMIT 0, 1000	1000 row(s) returned
✓ 19	13:34:24	SELECT * FROM fastest LIMIT 0, 1000	1000 row(s) returned
✗ 20	13:36:49	DELETE FROM fastest WHERE `rank` IS NULL	Error Code: 1175. You are using safe update mode and you tried to update a table without a WHERE that uses...

Successful Attempt: Updated Safe Mode Temporarily

2

3 • SET SQL\_SAFE\_UPDATES = 0;

4

5 • DELETE FROM fastest

6 WHERE `rank` IS NULL;

7

8 • SET SQL\_SAFE\_UPDATES = 1;

9

10 • SELECT \* FROM fastest;

Result Grid

	resultID	rank	fastestLap	fastestLapTime	fastestLapSpeed
▶	390	22	9	01:30:01	210.022
	565	22	16	01:25:00	217.698
	588	22	2	03:22:00	91.610
	610	22	4	01:26:01	181.824
	630	22	21	01:30:01	211.287
	698	22	19	02:05:01	130.749

fastest 15 x

Output

Action Output

#	Time	Action	Message
✓ 24	13:40:44	DELETE FROM fastest WHERE `rank` IS NULL	18249 row(s) affected
✓ 25	13:40:44	SET SQL_SAFE_UPDATES = 1	0 row(s) affected
✓ 26	13:40:44	SELECT * FROM fastest LIMIT 0, 1000	1000 row(s) returned