

F1 Database Management System

This presentation covers the design and implementation of an F1 database management system.

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Project Overview

- The Formula 1 Team Management System tackles key challenges within a data-rich and highly competitive sporting environment.
- By centralizing team operations, the system facilitates real-time decisions, efficient resource allocation, and strategic planning.
- It enhances performance by integrating all facets of team management, spanning driver analytics to vehicle maintenance.
- It addresses major challenges such as Driver Performance Analysis, Car and Part Maintenance, and Sponsorship and Financial Management.

Database Design

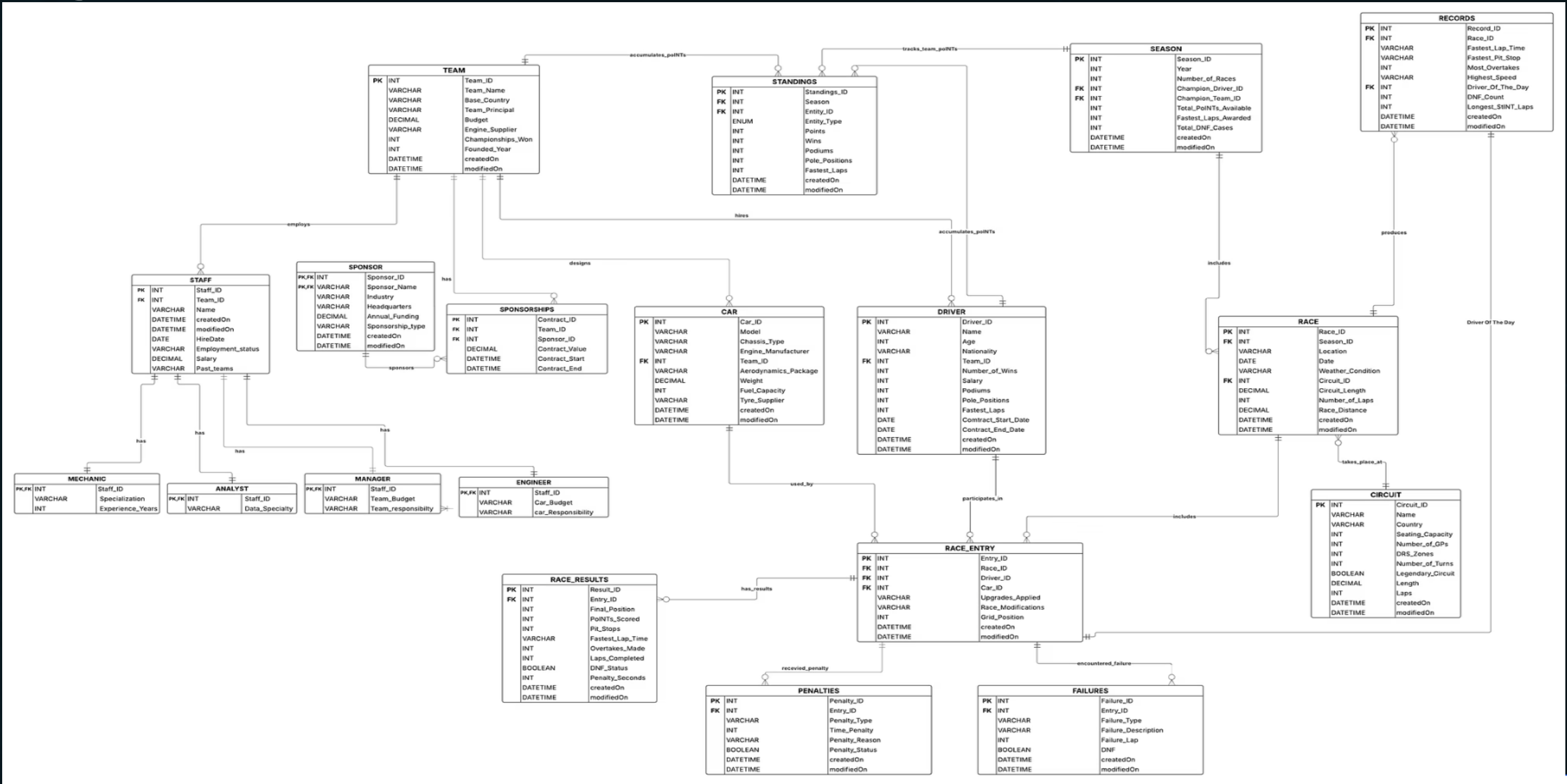
Entities

1. Driver
2. Race
3. Race_Info
4. Car
5. Car_Parts
6. Tires
7. Season
8. Records
9. Sponsor
10. Driver_Standings
11. Team_Standings
12. Team_Staff

Relationships

- One-to-many
- Many-to-many

Logical ERD



```
ed Mode is intended for safe code browsing. Trust this window to enable all features. Manage Learn M

create_tables.sql ×

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13 CREATE TABLE SPONSORSHIP (
14
15     Contract_End DATETIME NOT NULL,
16     FOREIGN KEY (Team_ID) REFERENCES TEAM(Team_ID),
17     FOREIGN KEY (Sponsor_ID) REFERENCES SPONSOR(Sponsor_ID),
18     CHECK (Contract_End > Contract_Start)
19 );
20
21 -- CAR table
22 CREATE TABLE CAR (
23     Car_ID INT PRIMARY KEY IDENTITY(1,1),
24     Model VARCHAR(50) NOT NULL,
25     Chassis VARCHAR(50) NOT NULL,
26     Engine_Manufacturer VARCHAR(50) NOT NULL,
27     Team_ID INT NOT NULL,
28     Aerodynamics_Package VARCHAR(50) NULL,
29     Weight DECIMAL(6,2) NOT NULL CHECK (Weight > 0),
30     Horsepower INT NULL CHECK (Horsepower > 0),
31     Tyre_Supplier VARCHAR(50) NULL,
32     CreatedOn DATETIME DEFAULT GETDATE(),
33     ModifiedOn DATETIME DEFAULT GETDATE(),
34     FOREIGN KEY (Team_ID) REFERENCES TEAM(Team_ID)
35 );
36
37 -- DRIVER table
38 CREATE TABLE DRIVER (
39     Driver_ID INT PRIMARY KEY IDENTITY(1,1),
40     Name VARCHAR(100) NOT NULL,
41     Age INT NOT NULL CHECK (Age >= 16 AND Age <= 65),
42     Nationality VARCHAR(50) NOT NULL,
43     Team_ID INT NOT NULL,
44     Number_of_Wins INT DEFAULT 0 CHECK (Number_of_Wins >= 0),
45     Salary DECIMAL(12,2) NULL CHECK (Salary > 0),
46     Contract_End_Date DATE NULL,
47     Pole_Positions INT DEFAULT 0 CHECK (Pole_Positions >= 0),
48     Fastest_Laps INT DEFAULT 0 CHECK (Fastest_Laps >= 0),
49     Contract_Start_Date DATE NULL,
50     CreatedOn DATETIME DEFAULT GETDATE(),
51     ModifiedOn DATETIME DEFAULT GETDATE(),
52     FOREIGN KEY (Team_ID) REFERENCES TEAM(Team_ID),
53     CHECK (Contract_End_Date > Contract_Start_Date)
54 );
55
```

Data Definition

1

Tables

Define each table's structure.

2

Columns

Specify data types and constraints.

3

Keys

Establish primary and foreign keys.

Data Insertion

1

Raw Data

Gather F1 results.

2

Transform

Clean and validate.

3

Insert

Populate tables with accurate race data.

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```
'Baku City Circuit', 'Azerbaijan', 18500, 2, 2, 20, 6.003, 'Street'),
'Marina Bay Street Circuit', 'Singapore', 90000, 3, 3, 23, 5.063, 'Street'),
'Jeddah Corniche Circuit', 'Saudi Arabia', 36000, 3, 3, 27, 6.174, 'Street'),
'Losail International Circuit', 'Qatar', 40000, 1, 1, 16, 5.38, 'Permanent'),
'Circuit Gilles Villeneuve', 'Canada', 100000, 2, 2, 14, 4.361, 'Street'),
'Miami International Autodrome', 'United States', 85000, 3, 3, 19, 5.412, 'Street');
```

- Insert DRIVER data

```
INSERT INTO DRIVER (Name, Age, Nationality, Team_ID, Number_of_Wins, Salary, Contract_Start, Contract_End)
VALUES
```

```
'Max Verstappen', 27, 'Netherlands', 1, 60, 25000000.00, '2028-12-31', 40, 30, '2023-01-01'),
'Lewis Hamilton', 39, 'United Kingdom', 2, 103, 30000000.00, '2025-12-31', 104, 63, '2023-01-01'),
'Charles Leclerc', 26, 'Monaco', 3, 5, 15000000.00, '2026-12-31', 21, 7, '2019-01-01'),
'Lando Norris', 24, 'United Kingdom', 4, 3, 12000000.00, '2026-12-31', 6, 8, '2019-01-01'),
'Fernando Alonso', 43, 'Spain', 5, 32, 15000000.00, '2025-12-31', 22, 21, '2023-01-01'),
'Pierre Gasly', 28, 'France', 6, 1, 5000000.00, '2025-12-31', 0, 2, '2023-01-01'),
'Alex Albon', 28, 'Thailand', 7, 0, 3000000.00, '2025-12-31', 0, 0, '2022-01-01'),
'Yuki Tsunoda', 24, 'Japan', 8, 0, 1000000.00, '2025-12-31', 0, 0, '2021-01-01'),
'Valtteri Bottas', 35, 'Finland', 9, 10, 8000000.00, '2025-12-31', 20, 18, '2022-01-01'),
'Kevin Magnussen', 32, 'Denmark', 10, 0, 2000000.00, '2025-12-31', 1, 2, '2022-01-01'),
'Sergio Perez', 34, 'Mexico', 1, 7, 10000000.00, '2026-12-31', 3, 6, '2021-01-01'),
'George Russell', 26, 'United Kingdom', 2, 2, 8000000.00, '2025-12-31', 3, 5, '2022-01-01'),
'Carlos Sainz', 30, 'Spain', 3, 3, 12000000.00, '2024-12-31', 5, 4, '2021-01-01'),
'Oscar Piastri', 23, 'Australia', 4, 2, 3000000.00, '2025-12-31', 2, 3, '2023-01-01'),
'Lance Stroll', 25, 'Canada', 5, 0, 1000000.00, '2026-12-31', 1, 0, '2021-01-01'),
'Esteban Ocon', 27, 'France', 6, 1, 5000000.00, '2024-12-31', 0, 0, '2022-01-01'),
'Logan Sargeant', 25, 'United States', 7, 0, 1000000.00, '2024-12-31', 0, 0, '2023-01-01'),
'Daniel Ricciardo', 35, 'Australia', 8, 8, 6000000.00, '2024-12-31', 3, 16, '2023-01-01'),
'Zhou Guanyu', 25, 'China', 9, 0, 2000000.00, '2024-12-31', 0, 0, '2022-01-01'),
'Nico Hulkenberg', 37, 'Germany', 10, 0, 2000000.00, '2024-12-31', 1, 2, '2023-01-01');
```

- Update SEASONS as drivers now exist

```
UPDATE SEASON SET Champion_Driver_ID = 1, Champion_Team_ID = 1 WHERE Year = 2022;
UPDATE SEASON SET Champion_Driver_ID = 1, Champion_Team_ID = 1 WHERE Year = 2021;
UPDATE SEASON SET Champion_Driver_ID = 2, Champion_Team_ID = 2 WHERE Year = 2020;
UPDATE SEASON SET Champion_Driver_ID = 1, Champion_Team_ID = 1 WHERE Year = 2023;
UPDATE SEASON SET Champion_Driver_ID = 1, Champion_Team_ID = 1 WHERE Year = 2024;
```

- Insert CAR data

```
INSERT INTO CAR (Model, Chassis, Engine_Manufacturer, Team_ID, Aerodynamics_Package, Price)
VALUES
```

```
'RB20', 'RB20', 'Honda RBPT', 1, 'High Downforce', 798.00, 1050, 'Pirelli'),
'W15', 'W15', 'Mercedes', 2, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-24', 'F1-24', 'Ferrari', 3, 'Medium Downforce', 798.00, 1045, 'Pirelli'),
'F1-23', 'F1-23', 'Red Bull', 4, 'High Downforce', 798.00, 1050, 'Pirelli'),
'F1-22', 'F1-22', 'McLaren', 5, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-21', 'F1-21', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-20', 'F1-20', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-19', 'F1-19', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-18', 'F1-18', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-17', 'F1-17', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-16', 'F1-16', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-15', 'F1-15', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-14', 'F1-14', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-13', 'F1-13', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-12', 'F1-12', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-11', 'F1-11', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-10', 'F1-10', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-09', 'F1-09', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-08', 'F1-08', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-07', 'F1-07', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-06', 'F1-06', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-05', 'F1-05', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-04', 'F1-04', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-03', 'F1-03', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-02', 'F1-02', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli'),
'F1-01', 'F1-01', 'Alfa Romeo', 6, 'Medium Downforce', 798.00, 1040, 'Pirelli');
```

mode 0 0 0 0 0

```

15      r.Location,
16      r1.DRIVER_ID AS Driver1ID,
17      r1.Final_Position AS Driver1Position,
18      r2.DRIVER_ID AS Driver2ID,
19      r2.Final_Position AS Driver2Position

```

Results Messages

	Driver1Name	Driver2Name	TotalRaces	Driver1Wins	Driver2Wins	Draws	Driver1Podiums	Driver2Podiums	Driver1AvgPosition
1	Max Verstappen	Lewis Hamilton	20	17	1	2	17	5	2.850000

Stored & User-Defined Procedures

Stored Procedures

We have designed these stored procedures to streamline data retrieval and analysis:

1. GetTopDriversByCircuit
2. GetDriverFullStats
3. GetTeamAndDriversSeasonPerformance

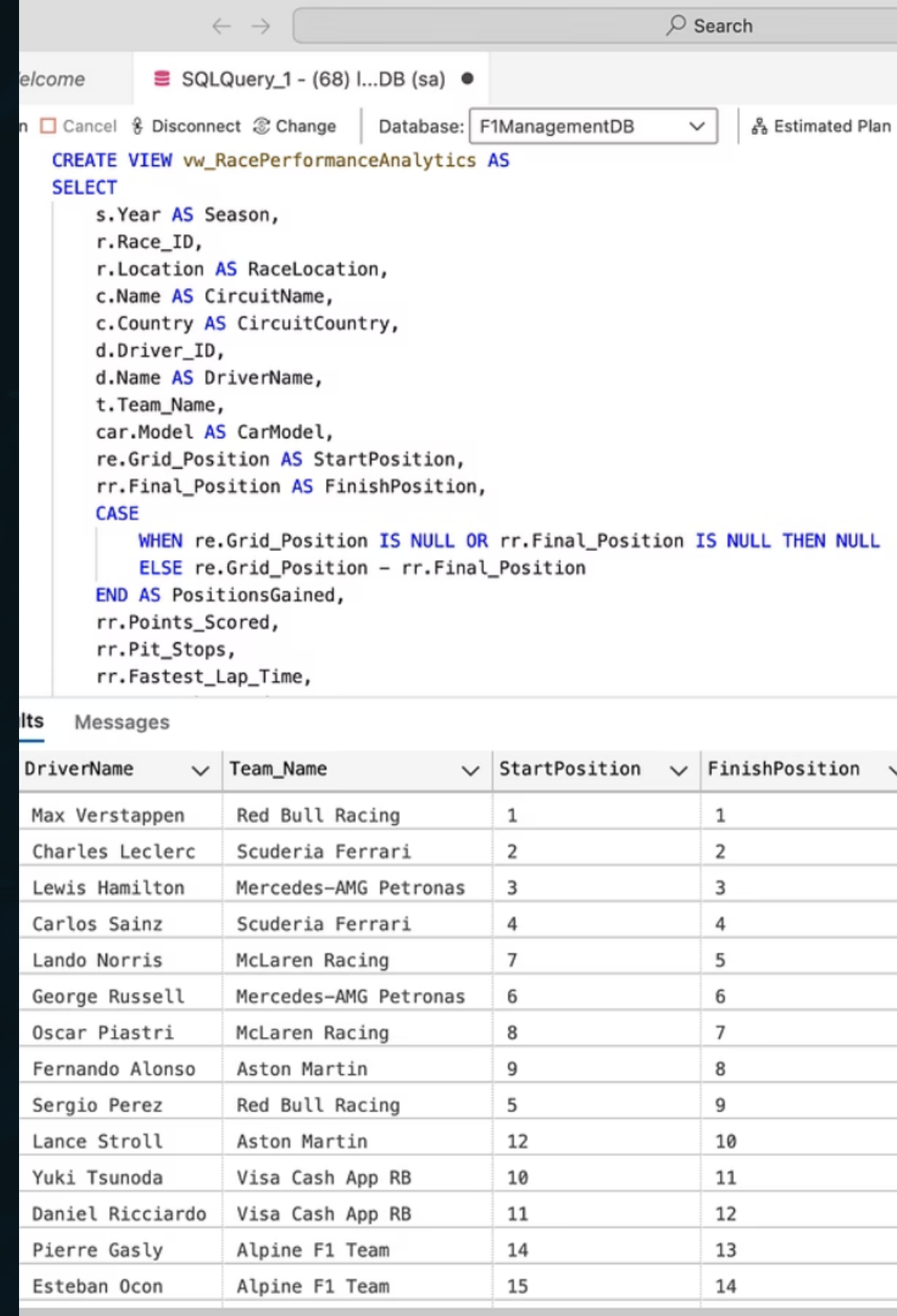
User-Defined Functions

Custom functions that allow for modular and reusable code, enhancing query efficiency and data consistency.

1. DriverAverageFinishPosition
2. TeamPerformanceScore
3. MostSuccessfulDriverAtCircuit
4. DriverHeadToHead

Views

Views act as virtual tables derived from SQL queries, offering a customized and simplified representation of underlying data. They enhance data security by restricting user access to specific columns or rows, and simplify complex queries by encapsulating them within a single, easily accessible object.



The screenshot displays the SQL Server Enterprise Manager interface. The top pane shows the SQL query editor with the following code:

```
CREATE VIEW vw_RacePerformanceAnalytics AS
SELECT
    s.Year AS Season,
    r.Race_ID,
    r.Location AS RaceLocation,
    c.Name AS CircuitName,
    c.Country AS CircuitCountry,
    d.Driver_ID,
    d.Name AS DriverName,
    t.Team_Name,
    car.Model AS CarModel,
    re.Grid_Position AS StartPosition,
    rr.Final_Position AS FinishPosition,
    CASE
        WHEN re.Grid_Position IS NULL OR rr.Final_Position IS NULL THEN NULL
        ELSE re.Grid_Position - rr.Final_Position
    END AS PositionsGained,
    rr.Points_Scored,
    rr.Pit_Stops,
    rr.Fastest_Lap_Time,
```

The bottom pane shows the 'Messages' tab with a table of results:

DriverName	Team_Name	StartPosition	FinishPosition
Max Verstappen	Red Bull Racing	1	1
Charles Leclerc	Scuderia Ferrari	2	2
Lewis Hamilton	Mercedes-AMG Petronas	3	3
Carlos Sainz	Scuderia Ferrari	4	4
Lando Norris	McLaren Racing	7	5
George Russell	Mercedes-AMG Petronas	6	6
Oscar Piastri	McLaren Racing	8	7
Fernando Alonso	Aston Martin	9	8
Sergio Perez	Red Bull Racing	5	9
Lance Stroll	Aston Martin	12	10
Yuki Tsunoda	Visa Cash App RB	10	11
Daniel Ricciardo	Visa Cash App RB	11	12
Pierre Gasly	Alpine F1 Team	14	13
Esteban Ocon	Alpine F1 Team	15	14

Triggers & Encryption



Triggers

A trigger is implemented to ensure adherence to driver contract terms. This trigger validates contract start and end dates, ensuring that the contract duration complies with Formula 1 regulations (typically not exceeding 5 years), thus maintaining data integrity and preventing regulatory breaches.



Encryption

To ensure confidentiality and prevent unauthorized access, sensitive financial data, including driver salaries, team staff compensation, and overall team budgets, is encrypted using advanced cryptographic techniques.

Formula 1 Circuits

Explore all Formula 1 race circuits around the world

Circuit Type:

All Types



Sort by:

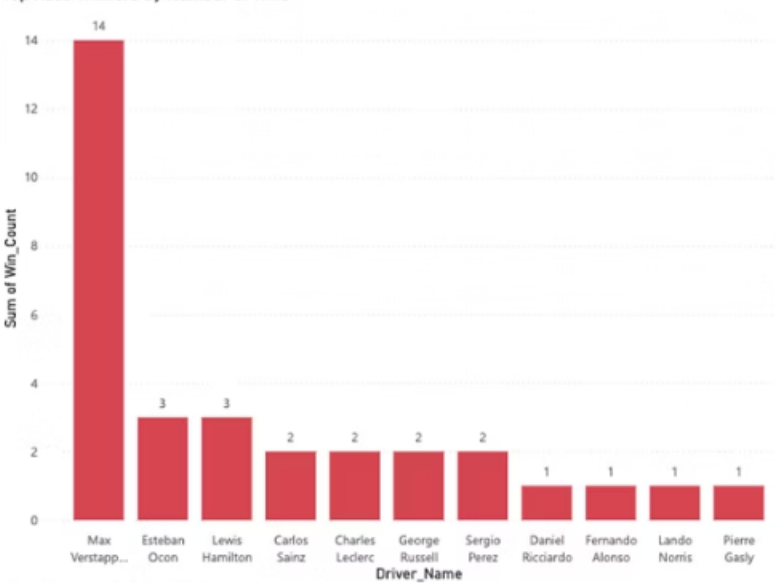
Name



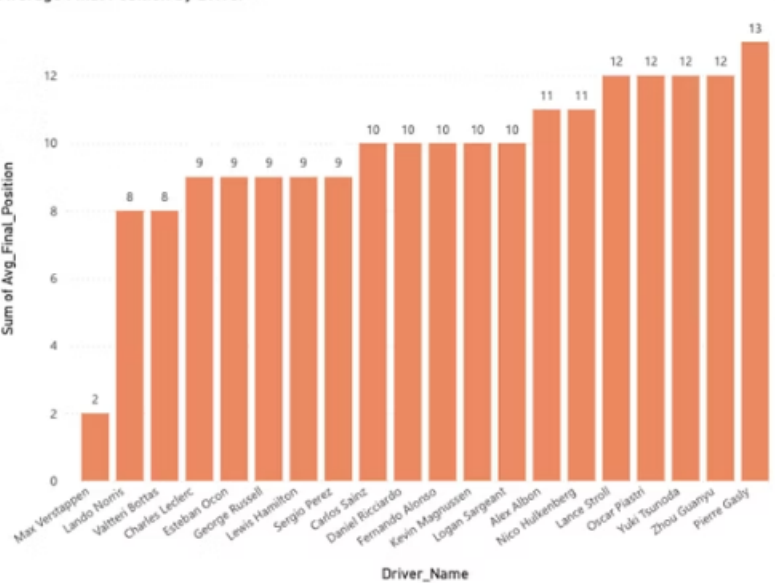
Sleek User Interface

Visualization Report

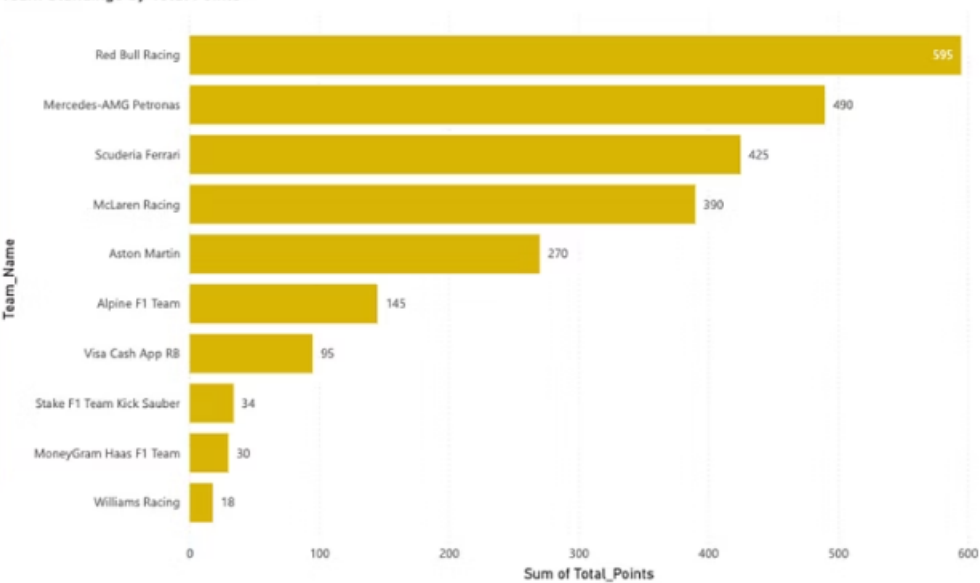
Top Race Winners by Number of Wins



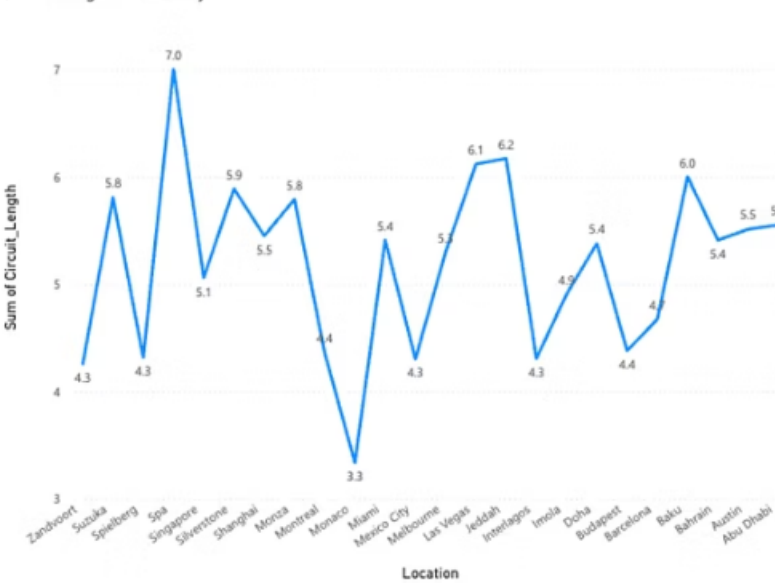
Average Final Position by Driver



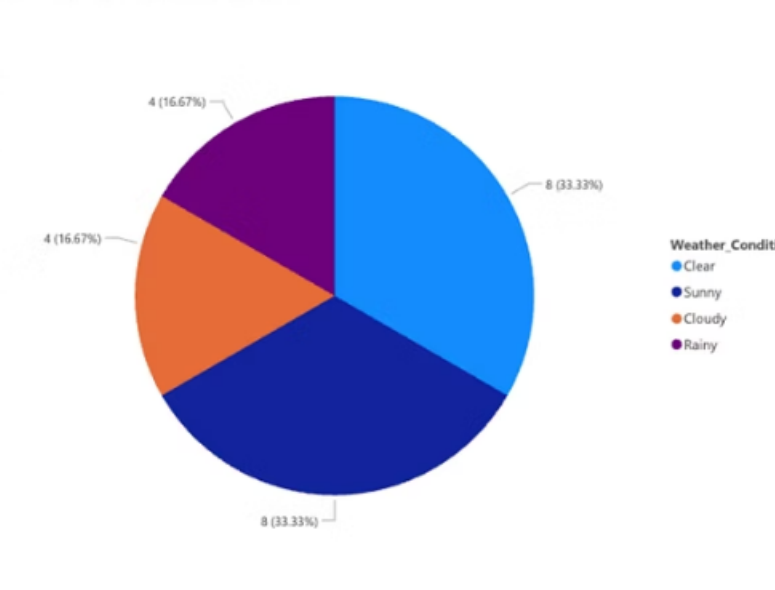
Team Standings by Total Points



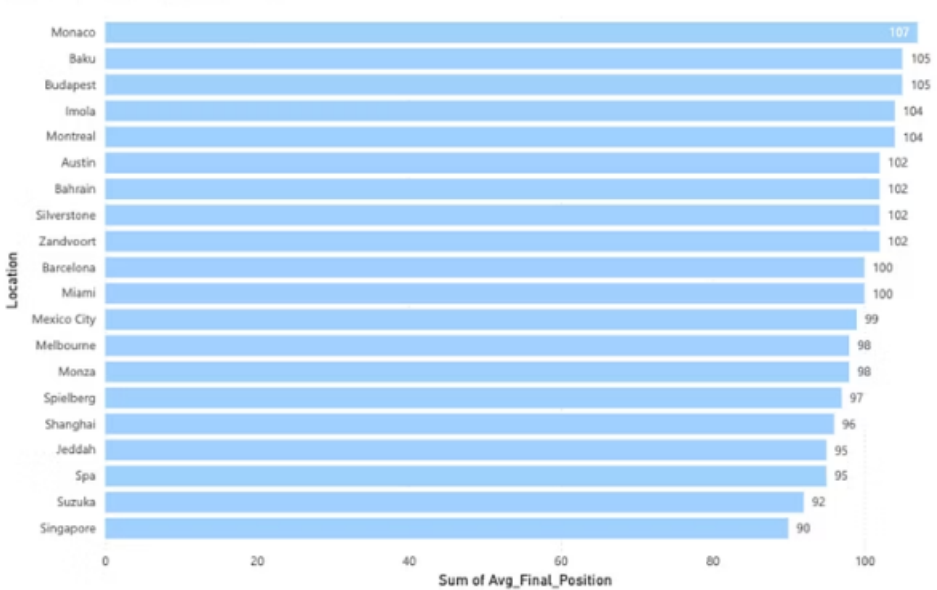
Circuit Length Variation by Location



Race Distribution by Weather Condition



Team Performance by Circuit Location



THANKYOU!

