RESEARCH ARTICLE

ANALYSING THE IMPORTANCE OF QUALIFYING IN FORMULA 1 USING THE FASTF1 LIBRARY IN PYTHON

Ranbir Grover

………………………………………………………………………………………………....

Manuscript Info	Abstract
……………………..	………………………………………………………………………
	Formula 1 cars are very difficult to set up. This paper uses data from the past 3 seasons to analyse whether the car setup, and driving style of a driver should be tailored majorly to race performance or whether a balance should be maintained so as to try and perform well in both the qualifying and race sessions. The FastF1 library has been used to extract driver, circuit, session and weather data in order to perform this analysis.

………………………………………………………………………………………………....

Introduction:-
What is a Formula One Grand Prix?
Formula One, or Formula 1, also called F1, one of the most popular sports in the worldis the highest class of international racing for single-seater formula racing cars. F1 is sanctioned by the Fédération Internationale de l'Automobile (FIA) which was established on 20 June 1904. Formula 1 was inaugurated on 13 May 1950 as the World Drivers' Championship at Silverstone in the United Kingdom. In 1981 it became known as the FIA Formula One World Championship.

Several races called Grand Prix are held all over the world over a season. These races taken together are called a Formula 1 season. The word 'Formula" refers to rules that all participating teams must adhere to. Grand Prix is a French word that translates as grand prize in English. The races are run of tracks that are graded "1" by the FIA. Hence the name Formula 1 was adopted.

Ten teams consisting of twenty drivers (two drivers per team) compete every season for two Championship awards based on the points scored in the season. They are**Drivers' Championship Award andConstructors' Championship Award.**

A F1 Grand Prix is held over a weekend. Friday is designated as a practice session day when two free practice sessions are held.

Qualifying sessions are held on Saturdays and the session will determine the starting order for the race. F1 Qualifying Sessions are when the drivers strive to set the fastest lap times which will determine their starting place on the starting grid. These positions are also referred to as QualifyingPositions. The driver who wins the qualifying session starts first in the race and is said to have got thePole position. The rest of the starting positions are also decided through qualifying timings.

The Grand Prix is held on Sunday and is the main event of the weekend.

Corresponding Author:- Ranbir Grover	1138

Fierce battles are witnessed between the ten teams for the ultimate title. The races are not without their fair share of drama, anticipation, sweat, tears, emotions, sponsorship and lots of money. It is what makes Formula 1 the most exciting as well as the most popular motor racing competition.

For the purpose of this research, I have chosen 5 famous drivers from different teams, and analysed their data over 10 races per season (totally 30 races) for the years 2019, 2020 and 2021.

The Cars
Every race weekend, the teams use the three practice sessions allotted to set their cars up in order to maximize performance. Setting the car up with low downforce may helps to increase the straight line speed, by virtue of drag reduction. This can help in overtaking during the race, but may compromise qualifying position due to lack of performance through turns. A high downforce setup has the opposite effect, so teams must find the perfect balance between a setup that can perform well in both race and qualifying conditions, thus making it necessary to analyse the importance of qualifying, so the balance can be perfected.

The Drivers
Lewis Hamilton {Team Mercedes} - 'Still I Rise' – these are the words emblazoned across the back of Lewis Hamilton's helmet and tattooed across his shoulders, and ever since annihilating expectations with one of the greatest rookie performances in F1 history in 2007, that's literally all he's done: risen to the top of the all-time Pole positions list ahead of his hero Ayrton Senna, surged into first place in the wins column surpassing the inimitable Michael Schumacher, and then matched the legendary German's seven world titles. [1]

Max Verstappen {Team Red Bull}He's Max by name, and max by nature. Arriving as Formula 1's youngest ever competitor at just 17 years old, Verstappen pushed his car, his rivals and the sport's record books to the limit. The baby-faced Dutchman with the heart of a lion took the Toro Rosso – and then the Red Bull – by the horns with his instinctive racing style.[1]

S Vettel {Team Aston Martin} Born and raised a Bull, then a Prancing Horse, and now the face of Aston Martin's Formula 1 revival, F1's poster boy of early achievement had won more than all but two drivers in history by the time he was just 26, including back-to-back world titles between 2010 and 2013. Vettel's trademark is pure pace – and of course his one-finger victory salute. In the chase to the chequered flag, he likes to lead from the front and just like his hero, Michael Schumacher. [1]

Lando Norris {Team McLaren} Lando Norris has flair and fighting spirit in bountiful supply. McLaren had the British teenager on their books for two years before fast-tracking him into F1's galaxy of stars in 2019. A firecracker in his junior career, with a penchant for Pole positions and wheel-to-wheel tussles, Norris didn't let them down.

Paired with the highly-rated – and far more experienced – Carlos Sainz, his rookie season was impressive, edging the Spaniard in their head-to-head qualifying battle, scoring points on 11 occasions, and only narrowly missing out on a top-10 championship placing. It was a similar pattern in 2020, with the affable Brit securing a maiden podium and moving up to ninth overall.

His unstoppable rise continued in 2021, with a further four podiums and almost a race win as he dominated another more senior teammate, Daniel Ricciardo, to move up to P6 in the final driver standings. [1]

C Leclerc {Team Ferrari} Born in the Mediterranean idyll of Monaco, Leclerc arrived in F1 on a tidal wave of expectation. Practically peerless on his way to the GP3 and Formula 2 crowns, he showcased a dazzling array of skills from scorching Pole positions, commanding victories – even when his car caught fire twice at Silverstone – to an ability to muscle his way through the pack. Winning back-to-back championships also taught Leclerc how to handle pressure, another useful tool in the big pond of Formula 1 racing.

Stepping up to F1 in 2018, Leclerc showed flashes of ballistic pace on Saturdays and racing brilliance on Sundays, dragging his Sauber beyond its limits – and earning himself a money-can't-buy race seat at Ferrari for 2019, stepping into the shoes of the Scuderia's last world champion, Kimi Raikkonen. [1]

Collection of Data
Formula 1 cars and the races generate a great amount of data.Every car has 150 to 300 sensors on average. It is estimated that around **300GB of data per car is generated each Grand Prix weekend.** Algorithms have been designed to analyse this data, whichcan provide competitive advantage to teams over others even before the car hits the track. Where did the driver and the team succeed and what failed, decides what to do in the future – improve car design, driver skills, adopt strategies like pit stops and many others. The data is used to run hundreds of simulations to optimize the car setup. Post-race data can be downloaded and analyzed easily, thanks to a Python library called Fast F1.

In this research I have used the Python library {Fast F1} that enables you to access F1 historical timing and telemetry data. This extracted data can then be utilized to perform various sorts of analysis.

The Fast F1 Library: The Fast-F1 library is an open-source python package for accessing F1 historical timing data and telemetry. FastF1 is built on top of Pandas DataFrames and Series. FastF1 uses openly available data from Ergast (http://ergast.com/mrd/). The official website also contains archived data from championships, beginning in 1950, up to the present day. This library can easily be installed via pip but requires Python version 3.8 or later. The Command to install the library is **pip install fastf1**

The analysis collects and manipulates the data over 3 years and 30 races to see the performance of these drivers in Qualifiers, the Final Races and the improvements in their positions (if any) in the final standing, as compared to their Pole positions in the Qualifying Races.

Importance of a Good Qualifying Position:
The first challenge for the driver in a race is getting a good grid or Qualifying position in the qualifying session.This definitely gives the driver an advantage over his fellow drivers as depending on his position in qualifiers, his starting position in the final race is decided. For example, the driver who qualifies in the first position is said to have achieved pole position and starts the race first, the driver who qualified second starts the race in the second position, and so on.The fastest lap time is dependent on many factors which help or restrict the driver from doing well – the ambient temperature, the challenges of the circuit, night or day race, track or city race, the car make, the tyres used, rains if any, the capability of the driver and the car, and scores of others.

Let's now see how to use the F1 library. We'll look at a few ways of accessing the data and visualizing the results. The documentation has a large amount of data which can be extracted extrapolated for a variety of parameters.

Importing necessary libraries and modules

```
import                         numpy                         as                         np
import            pandas            as            pdimport            matplotlib
import                    matplotlib.pyplot                    as                    plt
from            matplotlib.collections            import            LineCollection
from        matplotlib        import        cmimport        fastf1        as        ff1
from                    fastf1.core                    import            Laps
from                    fastf1                    import            utils
from                    fastf1                    import            plotting
plotting.setup_mpl()from timple.timedelta import strftimedelta
```

Create a Cache folderon your computer to speed up data loading otherwise it will take a long time to read the library each time the Python program is executed.

Methodology for Analysing the Data
1. I wrote a Python program to extract the data of all the drivers over all the races of the season for the years 2019, 2020 and 2021. The Python Program is at Annexure 1 and a sample of this data is at Annexure 2.
2. From this data I extracted the Qualifying Positions and the Final Positions of the5 drivers selected, in the selected 10 races per season.
3. I also extracted the data of all drivers (not only these 5 selected drivers) who had the first Pole position in all the races of the seasons in the years 2019, 2020 and 2021.

Analysing the data obtained from the F1 Library:
F1 races lay a lot of emphasis on the Qualifying Session of the specific race. Every driver tries hard to get to a better Qualifying position on the grid for the final day. How important is this Qualifying position in deciding the final race standing of these drivers?

To be able to view this as a screenshot, from the extracted data of these five drivers, I plotted their average positions in Qualifying and the Final Races over the three seasons. This gives us an indication of how they utilized their advantage of a good Qualifying position viz a viz the final race standing.

It is important to note that while the Qualifying session is on the lap time of the individual when he is alone on the track,the Final Day is more stressful as in addition to the challenges of the track and the ambient conditions, he has also to compete with other drivers trying to overtake him, and he must overtake other drivers in front; he has to avoid collisions etc.

From the graph below (Figure 1) the following can be deduced that:
1. Verstappen has always improved on his Qualifying position in the final race, every season, looking at his Average figures. He has utilized his advantage of a good Qualifying position to the fullest.
2. Hamilton has always been in the first 2, both in the qualifying and in the final race.
3. Vettel's average positions are ranging from 5 to 12 and he has not been able to dominate the final races by driving competitively and overtaking his opponents to secure a better final position. This is what the analysis shows us based on averages.
4. Norris has lost Qualifying position advantage in the final races.
5. Leclerc has shown great potential in 2019 but has slipped to the 8th and 9th position (average numbers) in the following years.
6. From the above analysis, while we know that Hamilton continues to be an ace and consistent performer, Verstappen has shown great potential and has used the advantage of his Qualifying position to the fullest.

This shows us that it is far more difficult to maintain qualifying positions in midfield cars as showcased by Norris and Vettel, whereas if you have a car capable of taking pole position, you are less likely to be involved in accidents and other incidents and therefore give yourself a better chance of maintaining your qualifying position.
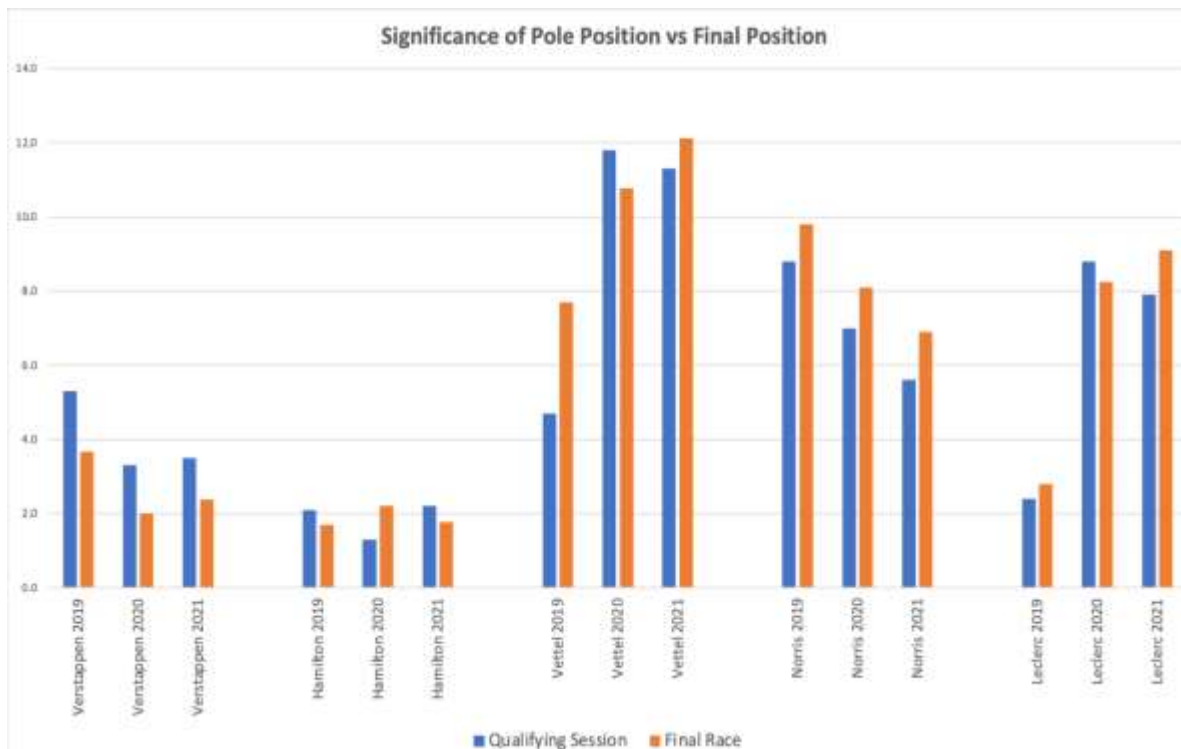

Figure 1:-

The graph below (Figure 2) analyses data in a different manner. Here I have taken the data as difference between Average Qualifying Position (year wise) Minus Average Final Position (year wise) of each of our 5 drivers. Here. A positive value will indicate an improvement of the driver from Qualifying to Final Race, showing potential of being a good competitor.

Here again, Verstappen stands out, being positive for all these three year and improving year on year! Hamilton had just one aberration in 2020. This has been primarily due to his performance in the Italian GP in 2020 where after being first offthe grid, he finished in the 7th position in the final day due to penalty imposed on him.
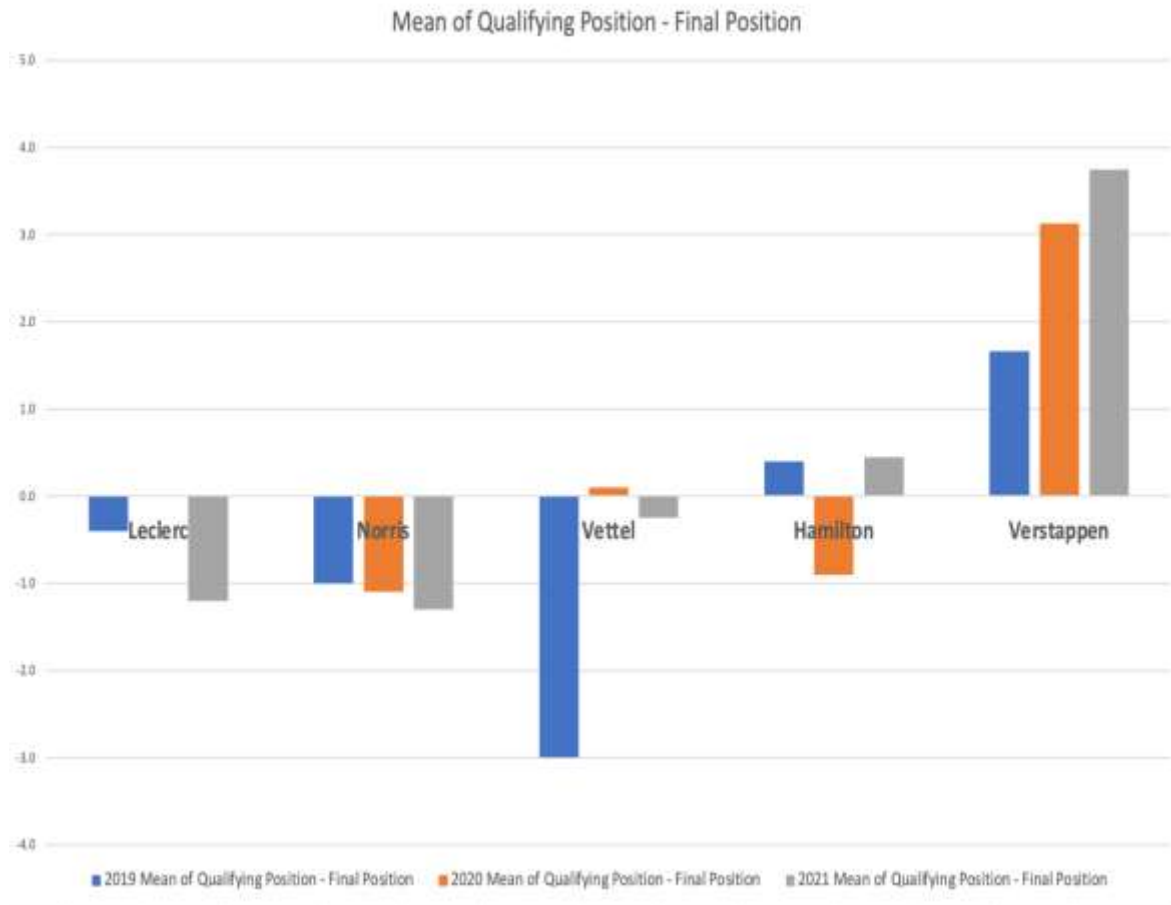

Figure 2:-

In the graphsbelow (Figures 3, 4 and 5) I have taken all the races that were conducted in each of the 3 seasons (2019, 2020, 2021) and have plotted the Final Race standing of drivers who had Pole position in the Qualifying session.

By this analysis it is evident that in 2019, in all races except two out of the 21 races of the season, drivers who had Pole position also won the podium position. Races in 2020 also showed similar trend, where in only 3 drivers in 16 races in the season, did not make it to the podium. In 2021,18 racesout of the 22 races held that year, the driver atPole position, finished the race within the first 5 positions. Half of the drivers (11 in number) came first and 3 more came second! It surely does tilt the scale in favour of a good Qualifying position to get a Podium finish or to be in the first 10 to score points for the driver in the final race!
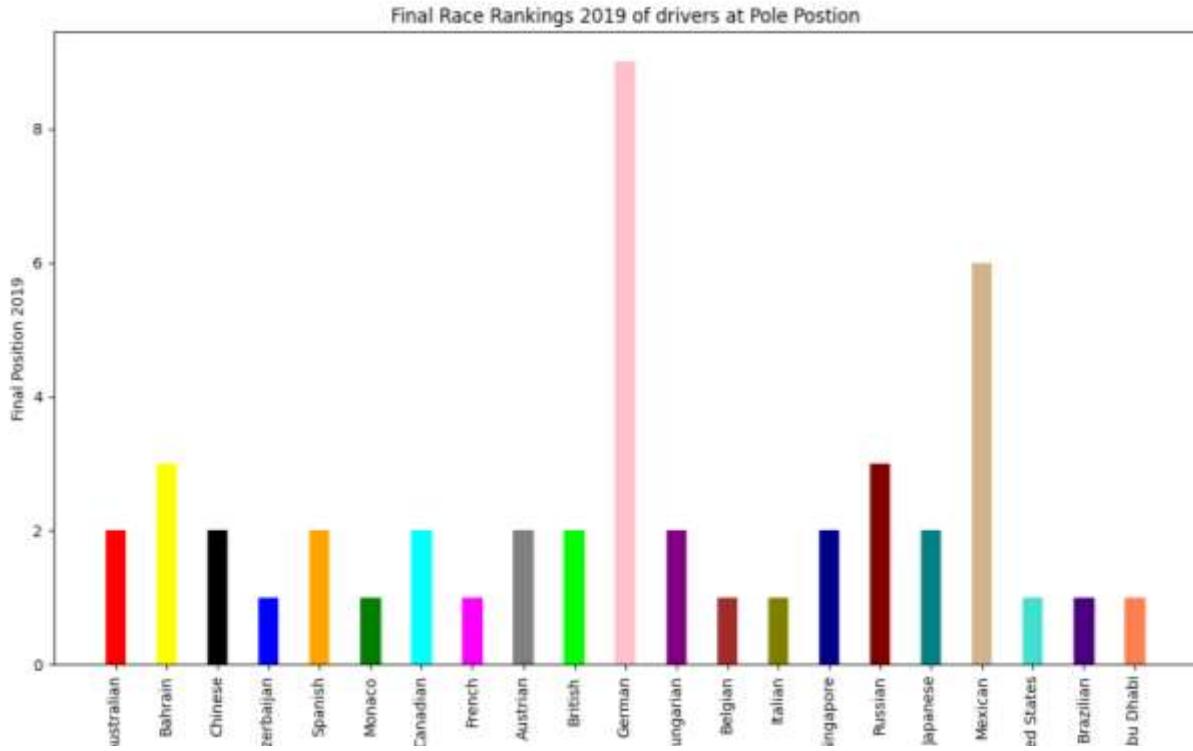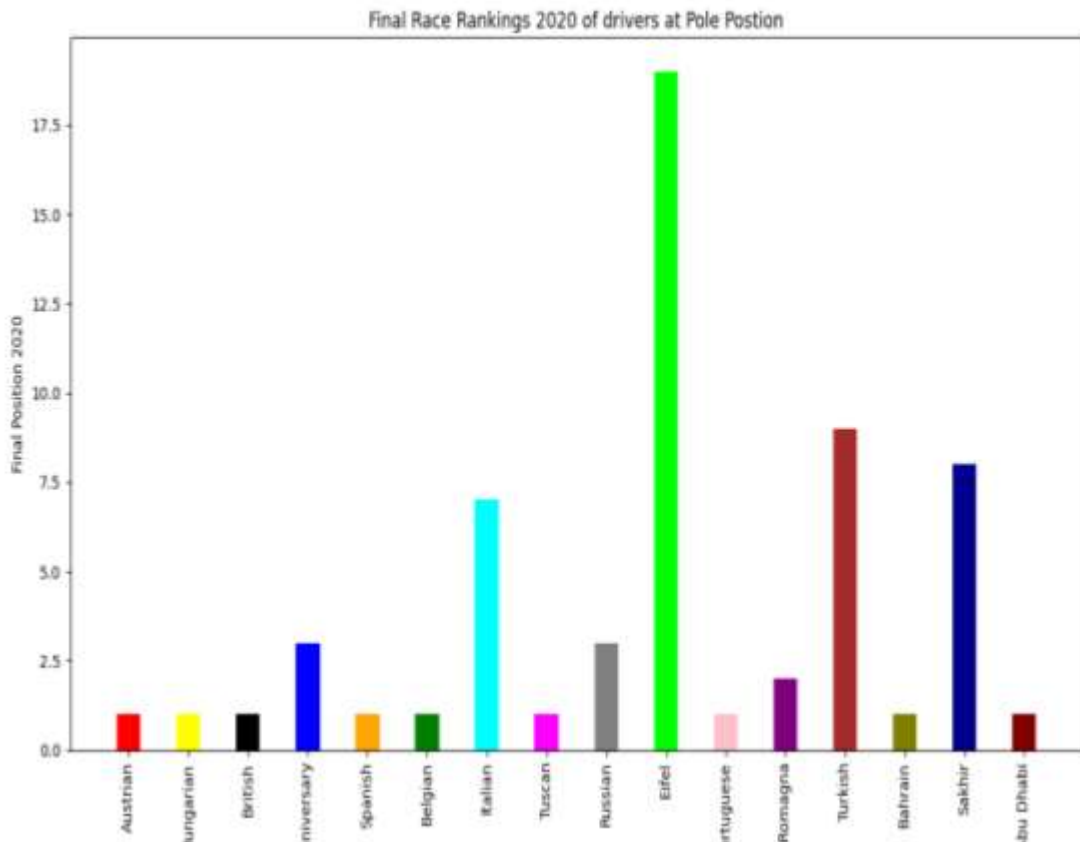
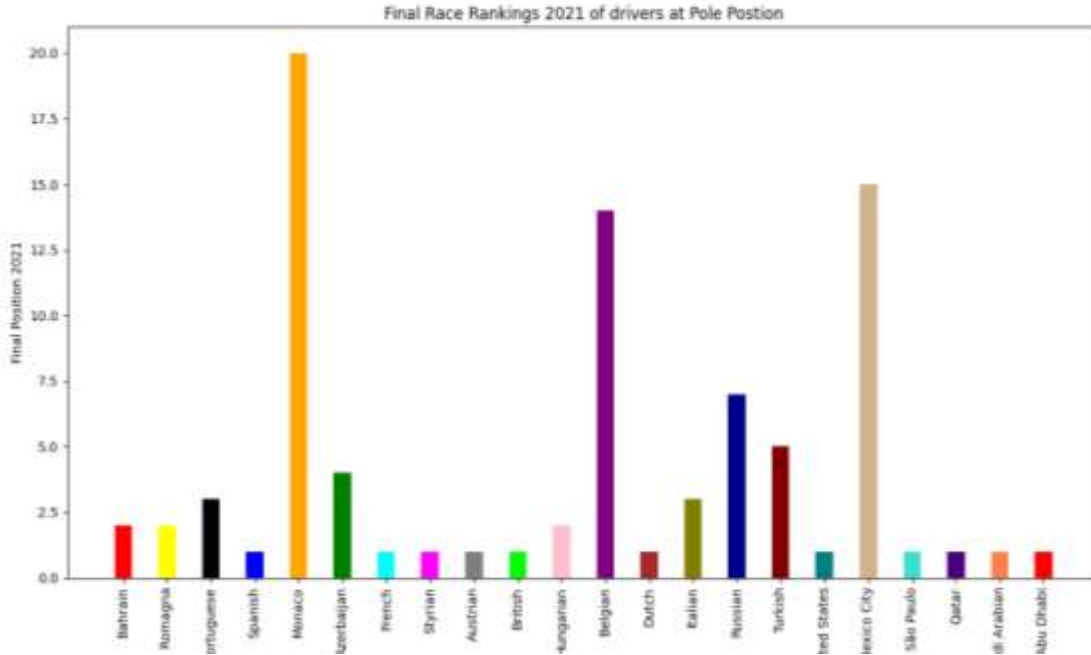**Figure 3:-**

Figure 4:-

Figure 5:-

Figure 6, given below shows the finishing position of the drivers on pole position at different circuits. Except for a few instances where drivers in midfield teams managed to qualify on Pole position, the results are quite consistent in that drivers starting higher up the grid tend to finish on top, even on circuits where overtaking is easier such as Belgium, Austria and Italy.Qualifying is of even higher importance however, at circuits like Monaco and Hungary where it is extremely difficult to overtake.
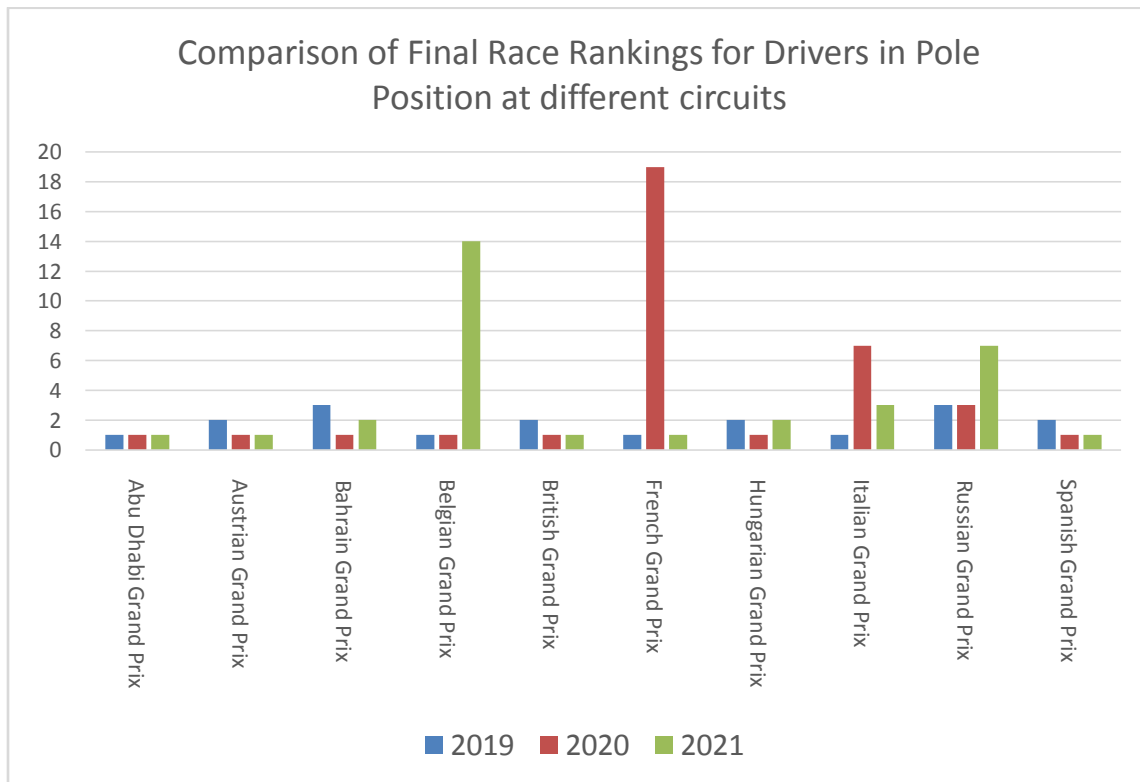

Figure 6:-

The Python code for extraction of the data is given below:

```
import matplotlib.pyplot as plt
import pandas as pd
from timple.timedelta import strftimedelta
import fastf1
import fastf1.plotting
from fastf1.core import Laps

fastf1.Cache.enable_cache(r"/Users/Sonya/Desktop")

final_list=[]
hamilton_list=[]
bottas_list=[]
leclerc_list=[]
norris_list=[]
vettel_list=[]
verstappen_list = []

for i in range(1,22):
    year = 2019
    qualifying = fastf1.get_session(2019, i , 'Q')
qualifying.load()
    race = fastf1.get_session(2019,i,'R')
race.load()
event_name = qualifying.event['EventName']
    drivers = pd.unique(qualifying.laps['Driver'])
fastest_laps = []
    for j in drivers:
fastest_lap = qualifying.laps.pick_driver(j).pick_fastest()
fastest_laps.append(fastest_lap)
final_sorted_list = Laps(fastest_laps).sort_values(by = 'LapTime').reset_index(drop=True)
pole_lap = final_sorted_list.pick_fastest()
drivernumber = pole_lap['DriverNumber']
race_results = race.results
qualifying_pos = 1
    driver = pole_lap['Driver']
i = race.get_driver(drivernumber)
    finish = str(int(i['Position']))
individual_event_list = []
hamilton_individual_event_list=["Hamilton"]
bottas_individual_event_list=["Bottas"]
norris_individual_event_list=["Norris"]
leclerc_individual_event_list = ["Leclerc"]
vettel_individual_event_list = ["Vettel"]
verstappen_individual_event_list = ["Verstappen"]
qualifying_results = qualifying.results
ver_qualifying = qualifying.get_driver('VER')
ver_race = race.get_driver('VER')
verstappen_race = str(int(ver_race['Position']))
verstappen_qualifying = str(int(ver_qualifying['Position']))
verstappen_individual_event_list.append(year)
verstappen_individual_event_list.append(event_name)
    verstappen_individual_event_list.append(int(verstappen_qualifying))
verstappen_individual_event_list.append(int(verstappen_race))
verstappen_list.append(verstappen_individual_event_list)
nor_qualifying = qualifying.get_driver('NOR')
```

```
nor_race = race.get_driver('NOR')
norris_race = str(int(nor_race['Position']))
norris_qualifying = str(int(nor_qualifying['Position']))
norris_individual_event_list.append(year)
norris_individual_event_list.append(event_name)
norris_individual_event_list.append(int(norris_qualifying))
norris_individual_event_list.append(int(norris_race))
norris_list.append(norris_individual_event_list)
vet_qualifying = qualifying.get_driver('VET')
vet_race = race.get_driver('VET')
vettel_race = str(int(vet_race['Position']))
vettel_qualifying = str(int(vet_qualifying['Position']))
vettel_individual_event_list.append(year)
vettel_individual_event_list.append(event_name)
vettel_individual_event_list.append(int(vettel_qualifying))
vettel_individual_event_list.append(int(vettel_race))
vettel_list.append(vettel_individual_event_list)
lec_qualifying = qualifying.get_driver('LEC')
lec_race = race.get_driver('LEC')
leclerc_race = str(int(lec_race['Position']))
leclerc_qualifying = str(int(lec_qualifying['Position']))
leclerc_individual_event_list.append(year)
leclerc_individual_event_list.append(event_name)
leclerc_individual_event_list.append(int(leclerc_qualifying))
leclerc_individual_event_list.append(int(leclerc_race))
leclerc_list.append(leclerc_individual_event_list)
bot_qualifying = qualifying.get_driver('BOT')
bot_race = race.get_driver('BOT')
bottas_race = str(int(bot_race['Position']))
bottas_qualifying = str(int(bot_qualifying['Position']))
bottas_individual_event_list.append(year)
bottas_individual_event_list.append(event_name)
bottas_individual_event_list.append(int(bottas_qualifying))
bottas_individual_event_list.append(int(bottas_race))
bottas_list.append(bottas_individual_event_list)
ham_qualifying = qualifying.get_driver('HAM')
ham_race = race.get_driver('HAM')
hamilton_race = str(int(ham_race['Position']))
hamilton_qualifying = str(int(ham_qualifying['Position']))
hamilton_individual_event_list.append(year)
hamilton_individual_event_list.append(event_name)
hamilton_individual_event_list.append(int(hamilton_qualifying))
hamilton_individual_event_list.append(int(hamilton_race))
hamilton_list.append(hamilton_individual_event_list)
individual_event_list.append(year)
individual_event_list.append(event_name)
individual_event_list.append(qualifying_pos)
individual_event_list.append(driver)
individual_event_list.append(finish)
final_list.append(individual_event_list)

for i in range(1,18):
    year = 2020
    qualifying = fastf1.get_session(2020, i , 'Q')
qualifying.load()
    race = fastf1.get_session(2020,i,'R')
```

```
race.load()
event_name = qualifying.event['EventName']
individual_event_list = []
    if(i==2):
individual_event_list.append(2020)
individual_event_list.append('Styrian Grand Prix')
individual_event_list.append(1)
individual_event_list.append('HAM')
individual_event_list.append(1)
    else:
        drivers = pd.unique(qualifying.laps['Driver'])
fastest_laps = []
        for j in drivers:
fastest_lap = qualifying.laps.pick_driver(j).pick_fastest()
fastest_laps.append(fastest_lap)
final_sorted_list = Laps(fastest_laps).sort_values(by = 'LapTime').reset_index(drop=True)
pole_lap = final_sorted_list.pick_fastest()
        driver = pole_lap['Driver']
drivernumber = pole_lap['DriverNumber']
race_results = race.results
qualifying_pos = 1
race_pos = race.get_driver(drivernumber)
        finish = str(int(race_pos['Position']))
individual_event_list = []
hamilton_individual_event_list=["Hamilton"]
bottas_individual_event_list=["Bottas"]
leclerc_individual_event_list = ["Leclerc"]
norris_individual_event_list=["Norris"]
vettel_individual_event_list = ["Vettel"]
verstappen_individual_event_list = ["Verstappen"]
qualifying_results = qualifying.results
nor_qualifying = qualifying.get_driver('NOR')
nor_race = race.get_driver('NOR')
norris_race = str(int(nor_race['Position']))
norris_qualifying = str(int(nor_qualifying['Position']))
norris_individual_event_list.append(year)
norris_individual_event_list.append(event_name)
norris_individual_event_list.append(int(norris_qualifying))
norris_individual_event_list.append(int(norris_race))
norris_list.append(norris_individual_event_list)
ver_qualifying = qualifying.get_driver('VER')
ver_race = race.get_driver('VER')
verstappen_race = str(int(ver_race['Position']))
verstappen_qualifying = str(int(ver_qualifying['Position']))
verstappen_individual_event_list.append(year)
verstappen_individual_event_list.append(event_name)
        verstappen_individual_event_list.append(int(verstappen_qualifying))
verstappen_individual_event_list.append(int(verstappen_race))
verstappen_list.append(verstappen_individual_event_list)
vet_qualifying = qualifying.get_driver('VET')
vet_race = race.get_driver('VET')
vettel_race = str(int(vet_race['Position']))
vettel_qualifying = str(int(vet_qualifying['Position']))
vettel_individual_event_list.append(year)
vettel_individual_event_list.append(event_name)
vettel_individual_event_list.append(int(vettel_qualifying))
```

```
vettel_individual_event_list.append(int(vettel_race))
vettel_list.append(vettel_individual_event_list)
lec_qualifying = qualifying.get_driver('LEC')
lec_race = race.get_driver('LEC')
leclerc_race = str(int(lec_race['Position']))
leclerc_qualifying = str(int(lec_qualifying['Position']))
leclerc_individual_event_list.append(year)
leclerc_individual_event_list.append(event_name)
leclerc_individual_event_list.append(int(leclerc_qualifying))
leclerc_individual_event_list.append(int(leclerc_race))
leclerc_list.append(leclerc_individual_event_list)
bot_qualifying = qualifying.get_driver('BOT')
bot_race = race.get_driver('BOT')
bottas_race = str(int(bot_race['Position']))
bottas_qualifying = str(int(bot_qualifying['Position']))
bottas_individual_event_list.append(year)
bottas_individual_event_list.append(event_name)
bottas_individual_event_list.append(int(bottas_qualifying))
bottas_individual_event_list.append(int(bottas_race))
bottas_list.append(bottas_individual_event_list)
    if ( i != 16):
ham_qualifying = qualifying.get_driver('HAM')
ham_race = race.get_driver('HAM')
hamilton_race = str(int(ham_race['Position']))
hamilton_qualifying = str(int(ham_qualifying['Position']))
hamilton_individual_event_list.append(year)
hamilton_individual_event_list.append(event_name)
hamilton_individual_event_list.append(int(hamilton_qualifying))
hamilton_individual_event_list.append(int(hamilton_race))
hamilton_list.append(hamilton_individual_event_list)
individual_event_list.append(year)
individual_event_list.append(event_name)
individual_event_list.append(qualifying_pos)
individual_event_list.append(driver)
individual_event_list.append(finish)
final_list.append(individual_event_list)


for i in range(1,23):
   year = 2021
   qualifying = fastf1.get_session(2021, i , 'Q')
qualifying.load()
   race = fastf1.get_session(2021,i,'R')
race.load()
event_name = qualifying.event['EventName']
   drivers = pd.unique(qualifying.laps['Driver'])
fastest_laps = []
   for j in drivers:
fastest_lap = qualifying.laps.pick_driver(j).pick_fastest()
fastest_laps.append(fastest_lap)
final_sorted_list = Laps(fastest_laps).sort_values(by = 'LapTime').reset_index(drop=True)
pole_lap = final_sorted_list.pick_fastest()
   driver = pole_lap['Driver']
race_results = race.results
drivernumber = pole_lap['DriverNumber']
qualifying_pos = 1
i = race.get_driver(drivernumber)
```

```
    finish = str(int(i['Position']))
individual_event_list = []
alonso_individual_event_list = ["Alonso"]
hamilton_individual_event_list=["Hamilton"]
bottas_individual_event_list=["Bottas"]
norris_individual_event_list=["Norris"]
leclerc_individual_event_list = ["Leclerc"]
vettel_individual_event_list = ["Vettel"]
verstappen_individual_event_list = ["Verstappen"]
    year = 2021
qualifying_results = qualifying.results
nor_qualifying = qualifying.get_driver('NOR')
nor_race = race.get_driver('NOR')
norris_race = str(int(nor_race['Position']))
norris_qualifying = str(int(nor_qualifying['Position']))
norris_individual_event_list.append(year)
norris_individual_event_list.append(event_name)
norris_individual_event_list.append(int(norris_qualifying))
norris_individual_event_list.append(int(norris_race))
norris_list.append(norris_individual_event_list)
ver_qualifying = qualifying.get_driver('VER')
ver_race = race.get_driver('VER')
verstappen_race = str(int(ver_race['Position']))
verstappen_qualifying = str(int(ver_qualifying['Position']))
verstappen_individual_event_list.append(year)
verstappen_individual_event_list.append(event_name)
    verstappen_individual_event_list.append(int(verstappen_qualifying))
verstappen_individual_event_list.append(int(verstappen_race))
verstappen_list.append(verstappen_individual_event_list)
vet_qualifying = qualifying.get_driver('VET')
vet_race = race.get_driver('VET')
vettel_race = str(int(vet_race['Position']))
vettel_qualifying = str(int(vet_qualifying['Position']))
vettel_individual_event_list.append(year)
vettel_individual_event_list.append(event_name)
vettel_individual_event_list.append(int(vettel_qualifying))
vettel_individual_event_list.append(int(vettel_race))
vettel_list.append(vettel_individual_event_list)
lec_qualifying = qualifying.get_driver('LEC')
lec_race = race.get_driver('LEC')
leclerc_race = str(int(lec_race['Position']))
leclerc_qualifying = str(int(lec_qualifying['Position']))
leclerc_individual_event_list.append(year)
leclerc_individual_event_list.append(event_name)
leclerc_individual_event_list.append(int(leclerc_qualifying))
leclerc_individual_event_list.append(int(leclerc_race))
leclerc_list.append(leclerc_individual_event_list)
bot_qualifying = qualifying.get_driver('BOT')
bot_race = race.get_driver('BOT')
bottas_race = str(int(bot_race['Position']))
bottas_qualifying = str(int(bot_qualifying['Position']))
bottas_individual_event_list.append(year)
bottas_individual_event_list.append(event_name)
bottas_individual_event_list.append(int(bottas_qualifying))
bottas_individual_event_list.append(int(bottas_race))
bottas_list.append(bottas_individual_event_list)
```

```
ham_qualifying = qualifying.get_driver('HAM')
ham_race = race.get_driver('HAM')
hamilton_race = str(int(ham_race['Position']))
hamilton_qualifying = str(int(ham_qualifying['Position']))
hamilton_individual_event_list.append(year)
hamilton_individual_event_list.append(event_name)
hamilton_individual_event_list.append(int(hamilton_qualifying))
hamilton_individual_event_list.append(int(hamilton_race))
hamilton_list.append(hamilton_individual_event_list)
individual_event_list.append(year)
individual_event_list.append(event_name)
individual_event_list.append(qualifying_pos)
individual_event_list.append(driver)
individual_event_list.append(finish)
final_list.append(individual_event_list)

for i in final_list:
    print(i)
for i in hamilton_list:
    print(i)
for i in vettel_list:
    print(i)
for i in verstappen_list:
    print(i)
for i in leclerc_list:
    print(i)
for i in norris_list:
    print(i)
```

Conclusion:-
In this Project, I have accessed the relevant F1 data for three years from the vast treasure of data (almost 300 GB per car) using Python Programming, extracted the subsets of this data, required for my analysis and used this data to bring out the correlation between the Qualifying position of the car and the final position in the Final race.

There are so many factors which affect the outcome of these F1 GPs where we have these 'supermen driving these state of the art, superfast machines'. These could be the ambient conditions, rains, soft or hard tyres, number of pitstops, early or late pitstops, and scores of other factors. There is therefore, the need to explore the Fast F1 library further for F1 enthusiasts. However, using this research it can definitely be concluded that qualifying is of importance in order to succeed in Formula 1. A race winning car must have a balanced setup that can perform well even in qualifying and not just on race day.Using this data, sky is the limit of your imagination of what all you can analyse and conclude in order to improve performance of the drivers in future races.

Bibliography:-
1. "F1 - The Official Home of Formula 1® Racing" - https://www.formula1.com
2. "What Is F1?"- https://f1chronicle.com/what-is-formula-1/
3. "Accessing Formula -1 Race's ⍰ historical data using Python - Analyzing the 2021 Abu Dhabi Grand Prix with the Fast F1 library" - https://pandeyparul.medium.com/accessing-formula-1-races-historical-data-using-python-b7c80e544f50
4. "FastF1 documentation" - https://theoehrly.github.io/Fast-F1/index.html
5. "Formula 1 Case Study" - https://aws.amazon.com/solutions/case-studies/formula-one/
6. "FastF1 and Raspberry PI: Formula 1 Professional Data with Python" - https://peppe8o.com/fastf1-and-raspberry-pi-formula-1-professional-data-with-python/
7. "FIA CHAMPIONSHIPS RESULTS & STATISTICS" - https://fiaresultsandstatistics.motorsportstats.com/
8. "Formula 1 Circuit Maps" - https://f1chronicle.com/formula-1-circuit-maps/