Formula 1 - analiza danych

January 26, 2024

1 Czyszczenie danych

Interesują nas tylko wyścigi od 1991 do 2022 roku (ze względu na zaszumienia np. wyścigi powyżej 200 okrążeń, sezon 2023 nie został w całości uwzględniony w tabeli results i by uwzględnić całą karierę Michaela Schumachera)

[ ]:

```
import sqlite3
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

db_name = 'f1.db'
connection = sqlite3.connect(db_name)

query = "SELECT ra.name, ra.year, d.forename || ' ' || d.surname AS␣
 ↪driver_name, c.name, re.positionOrder, re.laps, s.status FROM results re␣
 ↪INNER JOIN races ra ON ra.raceId = re.raceId INNER JOIN drivers d ON d.
 ↪driverId = re.driverId INNER JOIN constructors c ON c.constructorId = re.
 ↪constructorId INNER JOIN status s ON s.statusId = re.statusId"
result = connection.execute(query).fetchall()

columns = ["race_name", "race_year", "driver_name", "constructor_name",␣
 ↪"driver_final_position", "laps_driven", "ending"]

df = pd.DataFrame(result, columns=columns)

connection.close()

print(df)
```

```
                   race_name  race_year        driver_name constructor_name  \
0      Australian Grand Prix       2008     Lewis Hamilton          McLaren
1      Australian Grand Prix       2008      Nick Heidfeld       BMW Sauber
2      Australian Grand Prix       2008       Nico Rosberg         Williams
3      Australian Grand Prix       2008    Fernando Alonso          Renault
4      Australian Grand Prix       2008  Heikki Kovalainen          McLaren
…                        …        …                  …              …
11434   Abu Dhabi Grand Prix       2022    Mick Schumacher     Haas F1 Team
11435   Abu Dhabi Grand Prix       2022    Kevin Magnussen     Haas F1 Team
```

```
11436   Abu Dhabi Grand Prix       2022     Lewis Hamilton         Mercedes
11437   Abu Dhabi Grand Prix       2022    Nicholas Latifi         Williams
11438   Abu Dhabi Grand Prix       2022    Fernando Alonso   Alpine F1 Team

       driver_final_position  laps_driven            ending
0                          1           58          Finished
1                          2           58          Finished
2                          3           58          Finished
3                          4           58          Finished
4                          5           58          Finished
…                      …          …               …
11434                     16           57            +1 Lap
11435                     17           57            +1 Lap
11436                     18           55        Hydraulics
11437                     19           55  Collision damage
11438                     20           27        Water leak

[11439 rows x 7 columns]
```

2 Średnia

[ ]:

```python
def mean(values):
    mean = 0
    for value in values:
        mean += value
    mean /= len(values)
    return mean
```

3 Mediana

[ ]:

```python
def median(values):
    n = len(values)
    if n % 2 == 1:
        return values[n // 2 + 1]
    else:
        return (values[n // 2] + values[n // 2 + 1]) / 2
```

4 Rozstęp

[ ]:

```python
def sample_range(values):
    n = len(values)
    return values.iloc[n-1] - values.iloc[0]
```

5 Wariancja

[ ]:

```
def variance(values):
    n = len(values)
    m = mean(values)
    variance = 0
    for value in values:
        variance += (value - m) ** 2
    variance /= (n - 1)
    return variance
```

6 Średnie odchylenie

[ ]:

```
def average_deviation(values):
    n = len(values)
    deviation = 0
    m = mean(values)
    for value in values:
        deviation += abs(value - m)
    return deviation / n
```

7 Dolny kwartyl

[ ]:

```
def left_hinge(values):
    med = median(values)
    lower_values = []
    for value in values:
        if value <= med:
            lower_values.append(value)
    return median(lower_values)
```

8 Górny kwartyl

[ ]:

```
def right_hinge(values):
    med = median(values)
    upper_values = []
    for value in values:
        if value > med:
            upper_values.append(value)
    return median(upper_values)
```

[ ]:

```
def print_info(values):
    print("Mean:\n", round(mean(values), 2))
    print("Median:\n", round(median(values.tolist()), 2))

    print("Sample range:\n", round(sample_range(values), 2))

    print("Variance:\n", round(variance(values), 2))

    print("Standard deviation:\n", round(variance(values) ** (1 / 2), 2))

    print("Average deviation:\n", round(average_deviation(values), 2))

    print("Right hinge:\n", round(right_hinge(values.tolist()),2))

    print("Left hinge:\n", round(left_hinge(values.tolist()),2))
```

[ ]:

```
laps = df["laps_driven"].astype(int)
laps.sort_values(ascending=True, inplace=True)
print(laps)
```

```
916       0
1308      0
1307      0
5113      0
5112      0
         ..
10527    87
10529    87
10530    87
10523    87
10526    87
Name: laps_driven, Length: 11439, dtype: int64
```

[ ]:

```
print_info(laps)
```

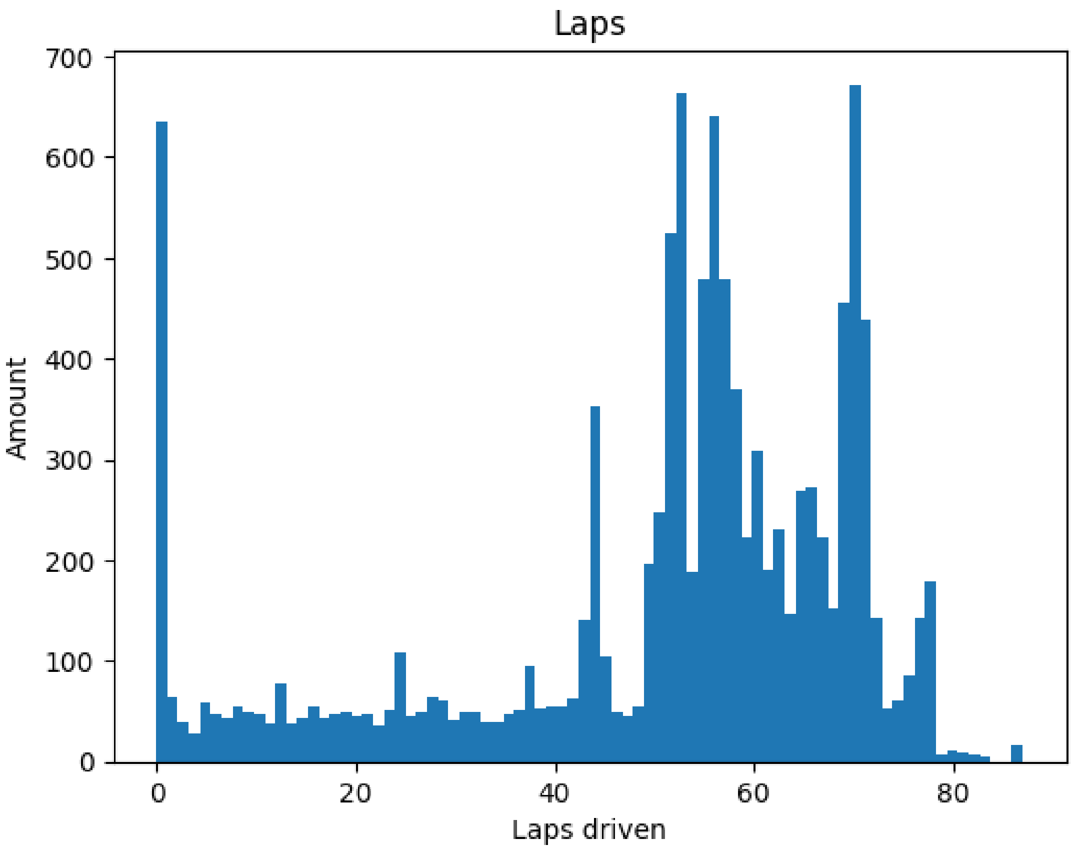
```
Mean:
 50.32
Median:
 56
Sample range:
 87
Variance:
 434.14
Standard deviation:
 20.84
Average deviation:
 15.92
Right hinge:
 67
```

```
Left hinge:
 45.0
```

9 Histogram

[ ]:

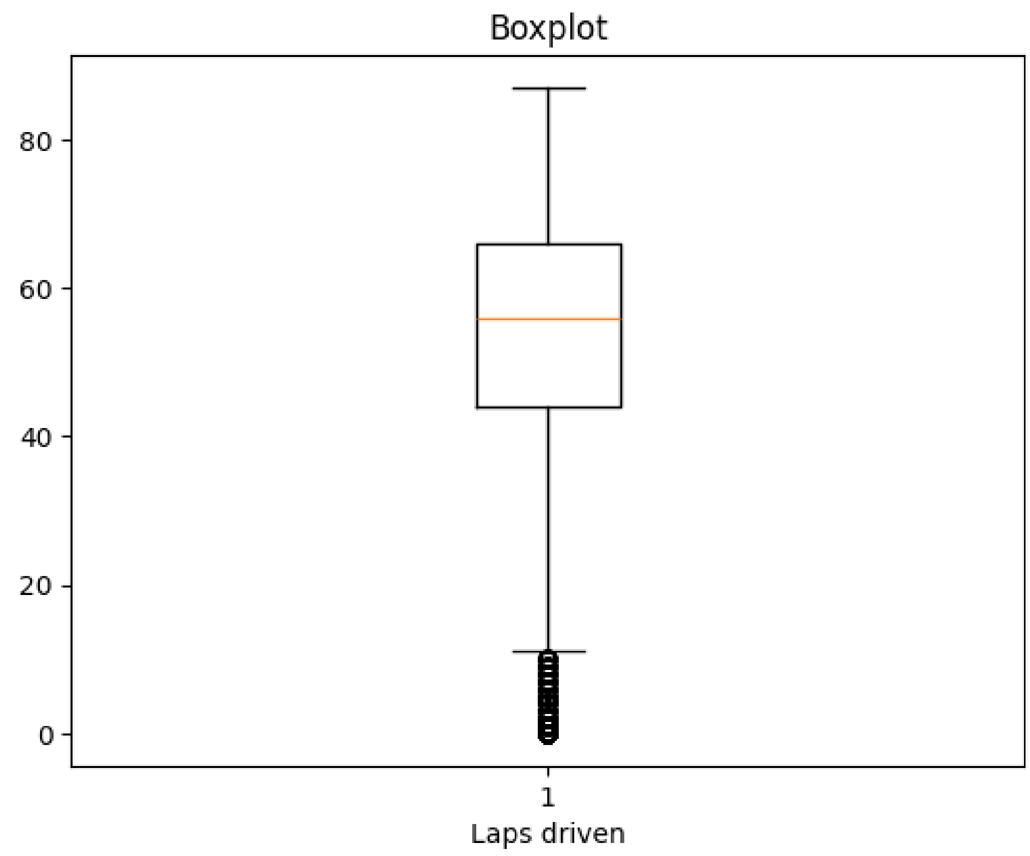
```
plt.hist(laps, bins=80)
plt.title("Laps")
plt.xlabel("Laps driven")
plt.ylabel("Amount")
plt.show()
```



10 Boxplot

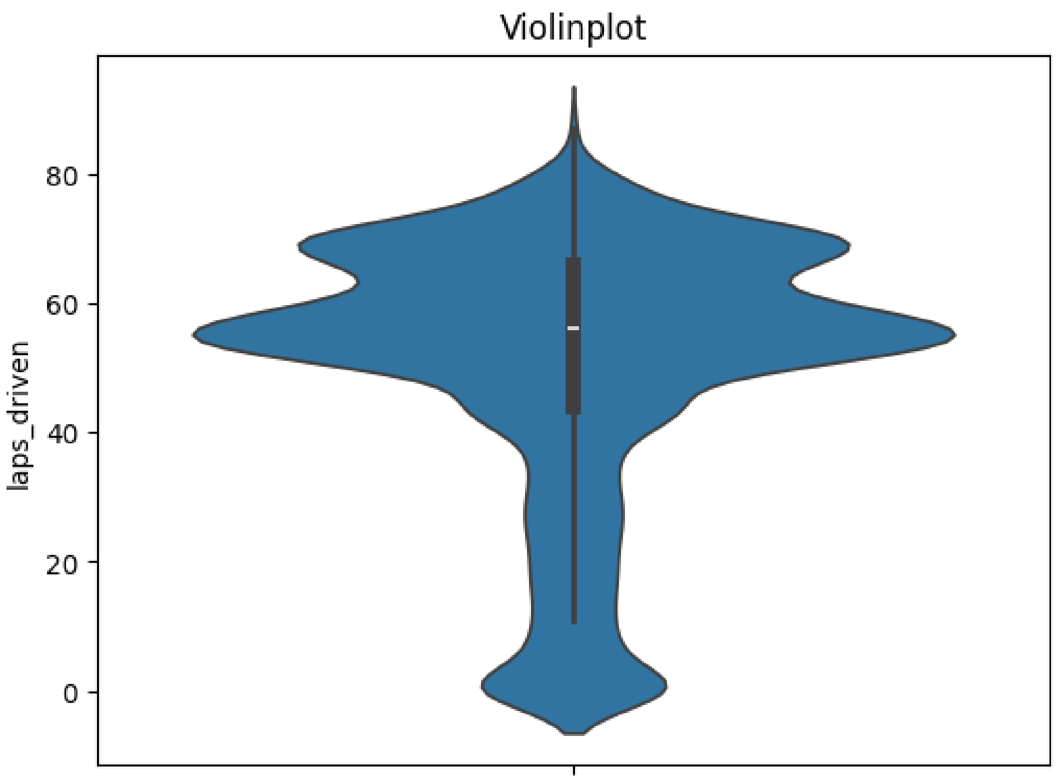
[ ]:

```
plt.boxplot(laps)
plt.title("Boxplot")
plt.xlabel("Laps driven")
plt.show()
```



11 Violinplot

```
[ ]: sns.violinplot(laps)
     plt.title("Violinplot")
     plt.show()
```



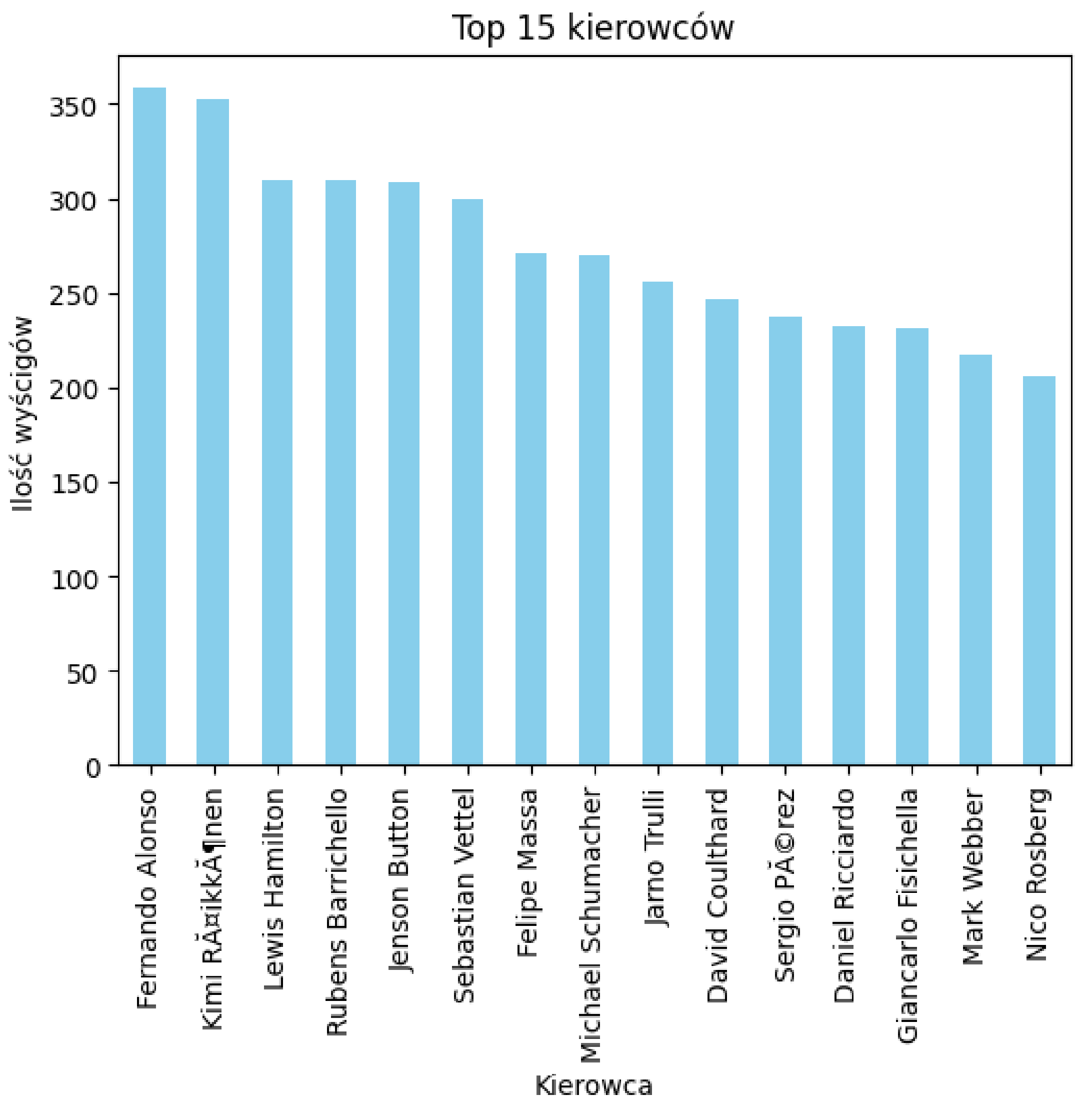
```
[ ]: drivers = df["driver_name"]
     print(drivers)
```

```
0           Lewis Hamilton
1            Nick Heidfeld
2             Nico Rosberg
3          Fernando Alonso
4        Heikki Kovalainen
              …
11434      Mick Schumacher
11435      Kevin Magnussen
11436       Lewis Hamilton
11437      Nicholas Latifi
11438      Fernando Alonso
Name: driver_name, Length: 11439, dtype: object
```

11.1 Kierowcy z największa ilością wyścigów

```
[ ]: top_drivers = drivers.value_counts()[:15]
     print(top_drivers)
     top_drivers.plot(kind='bar', color='skyblue')
     plt.title('Top 15 kierowców')
     plt.xlabel('Kierowca')
     plt.ylabel('Ilość wyścigów')
     plt.show()
```

```
driver_name
Fernando Alonso        358
Kimi RÃ¤ikkÃ¶nen        352
Lewis Hamilton         310
Rubens Barrichello     310
Jenson Button          309
Sebastian Vettel       300
Felipe Massa           271
Michael Schumacher     270
Jarno Trulli           256
David Coulthard        247
Sergio PÃ©rez           237
Daniel Ricciardo       232
Giancarlo Fisichella   231
Mark Webber            217
Nico Rosberg           206
Name: count, dtype: int64
```

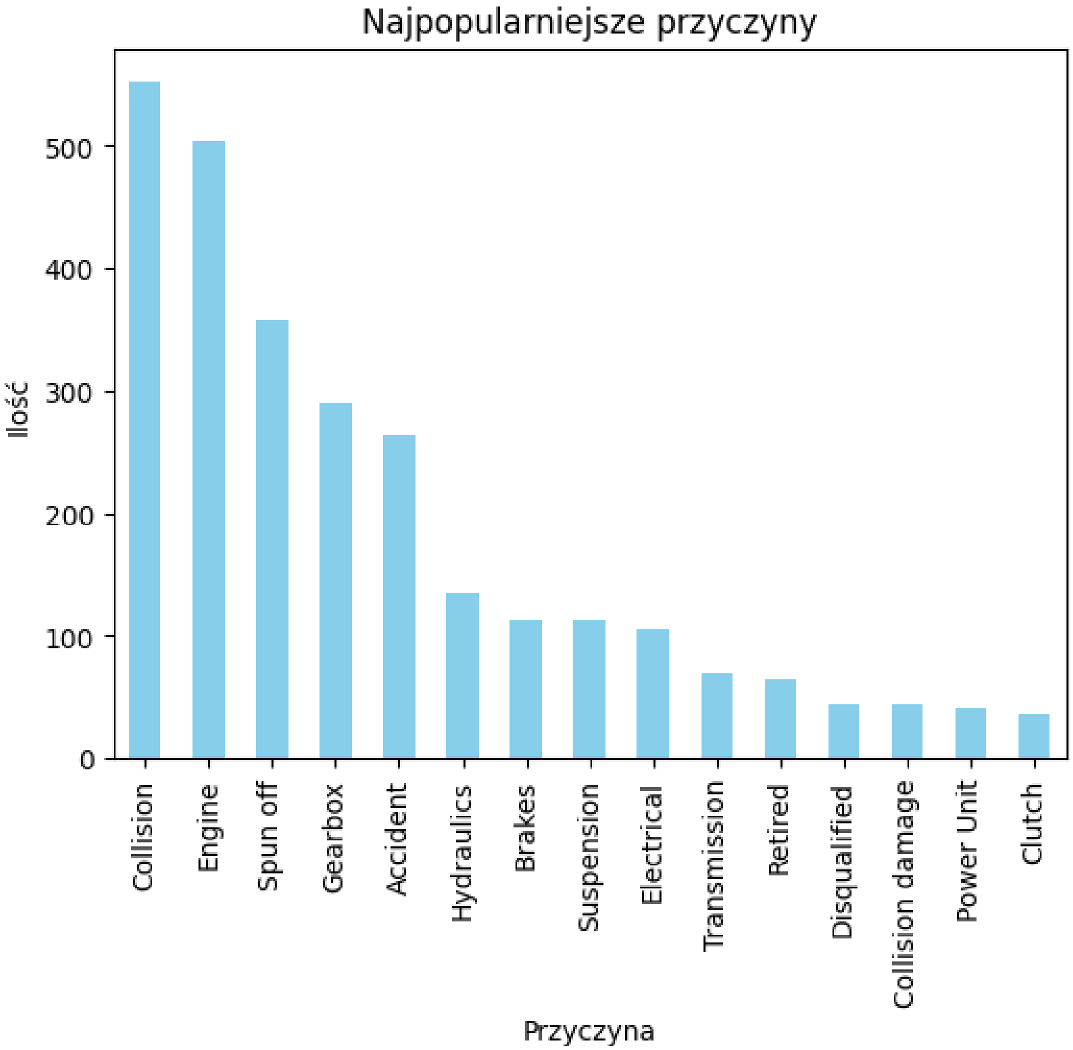


12 Najpopularniejsze przyczyny nieukończenia wyścigu (DNF)

[ ]:
```
dnfs = df[~df["ending"].str.contains(r'\b(?:Lap|Laps|Finished|Did not␣
  ↪qualify)\b', case=False, regex=True)]["ending"].value_counts()
print(dnfs)
dnfs[:15].plot(kind='bar', color='skyblue')
plt.title("Najpopularniejsze przyczyny")
plt.xlabel("Przyczyna")
plt.ylabel("Ilość")
plt.show()
```

```
ending
```

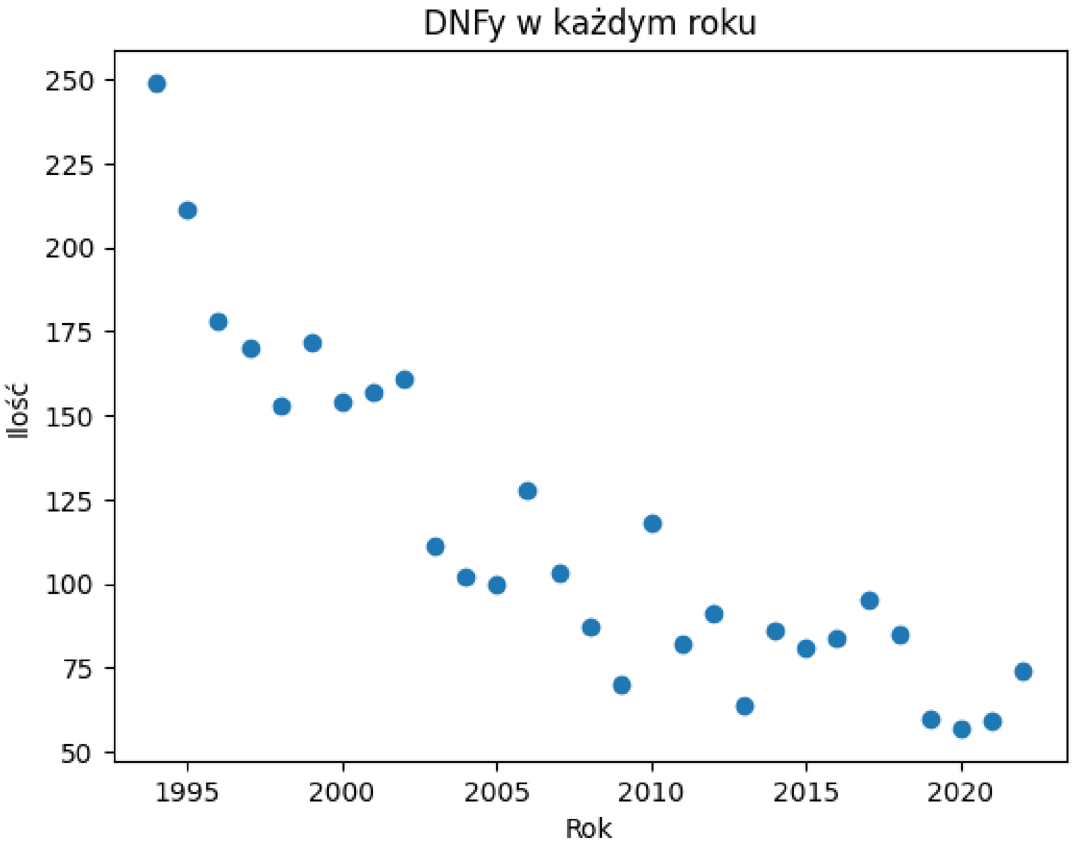
```
Collision        552
Engine           504
Spun off         358
Gearbox          291
Accident         264
                …
Chassis            1
Stalled            1
Tyre puncture      1
Engine fire        1
Underweight        1
Name: count, Length: 91, dtype: int64
```



13 Analiza przyczyn nieukończenia wyścigu

```
[ ]: dnfs2 = df[~df["ending"].str.contains(r'\b(?:Lap|Laps|Finished)\b', case=False,␣
      ↪regex=True)]['race_year']
     grouped_dnfs = dnfs2.value_counts().reset_index(name='count')
     print(grouped_dnfs)

     plt.scatter(grouped_dnfs['race_year'], grouped_dnfs['count'])
     plt.xlabel('Rok')
     plt.ylabel('Ilość')
     plt.title('DNFy w każdym roku')
     plt.show()
```

```
    race_year  count
0        1994    249
1        1995    211
2        1996    178
3        1999    172
4        1997    170
5        2002    161
6        2001    157
7        2000    154
8        1998    153
9        2006    128
10       2010    118
11       2003    111
12       2007    103
13       2004    102
14       2005    100
15       2017     95
16       2012     91
17       2008     87
18       2014     86
19       2018     85
20       2016     84
21       2011     82
22       2015     81
23       2022     74
24       2009     70
25       2013     64
26       2019     60
27       2021     59
28       2020     57
```



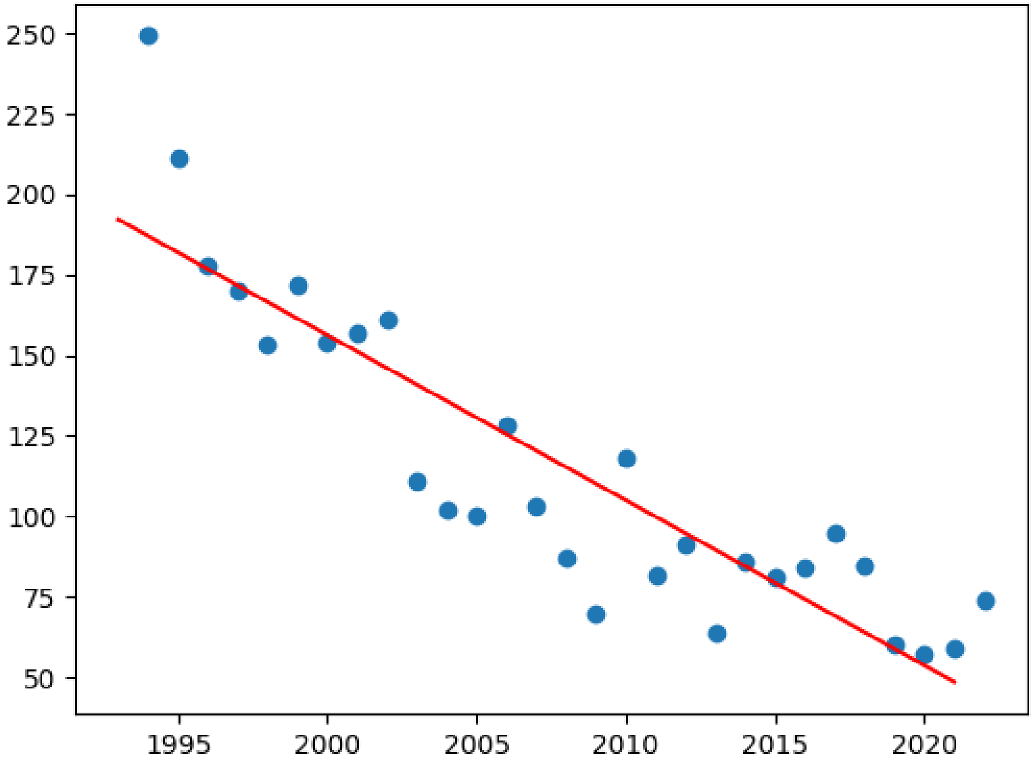
13.1 Regresja liniowa

[ ]:

```
def linear_regression(x_values, y_values):
    B = [x for x in range(5000, 15000, 600)]
    best_model_b = B[0]
    best_model_a = 0
    best_error = float("inf")
    learning_rate = 1e-7
    epochs = 100

    n = x_values.size
    for b in B:
        a = best_model_a
        for _ in range(epochs):
            dl_da = 0
            dl_db = 0
            for i in range(n):
                dl_da += (a * x_values[i] + b - y_values[i]) * x_values[i]
                dl_db += (a * x_values[i] + b - y_values[i])
            # gradient descent
            a -= 2/n * dl_da * learning_rate
            b -= 2/n * dl_db * learning_rate

        error = 0
        for i in range(x_values.size):
            error += (a * x_values[i] + b - y_values[i]) ** 2
        if error < best_error:
            best_error = error
            best_model_b = b
            best_model_a = a
    print(best_model_a, best_model_b, best_error)

    plt.scatter(x_values, y_values)
    plt.plot(list(range(1993, 2022)), [best_model_a * x + best_model_b for x in␣
 ↪range(1993, 2022)], color="red")
    plt.show()
```

[ ]:
```
linear_regression(grouped_dnfs['race_year'], grouped_dnfs['count'])
```

```
-5.121891597085801 10399.999851195094 14361.207011753331
```

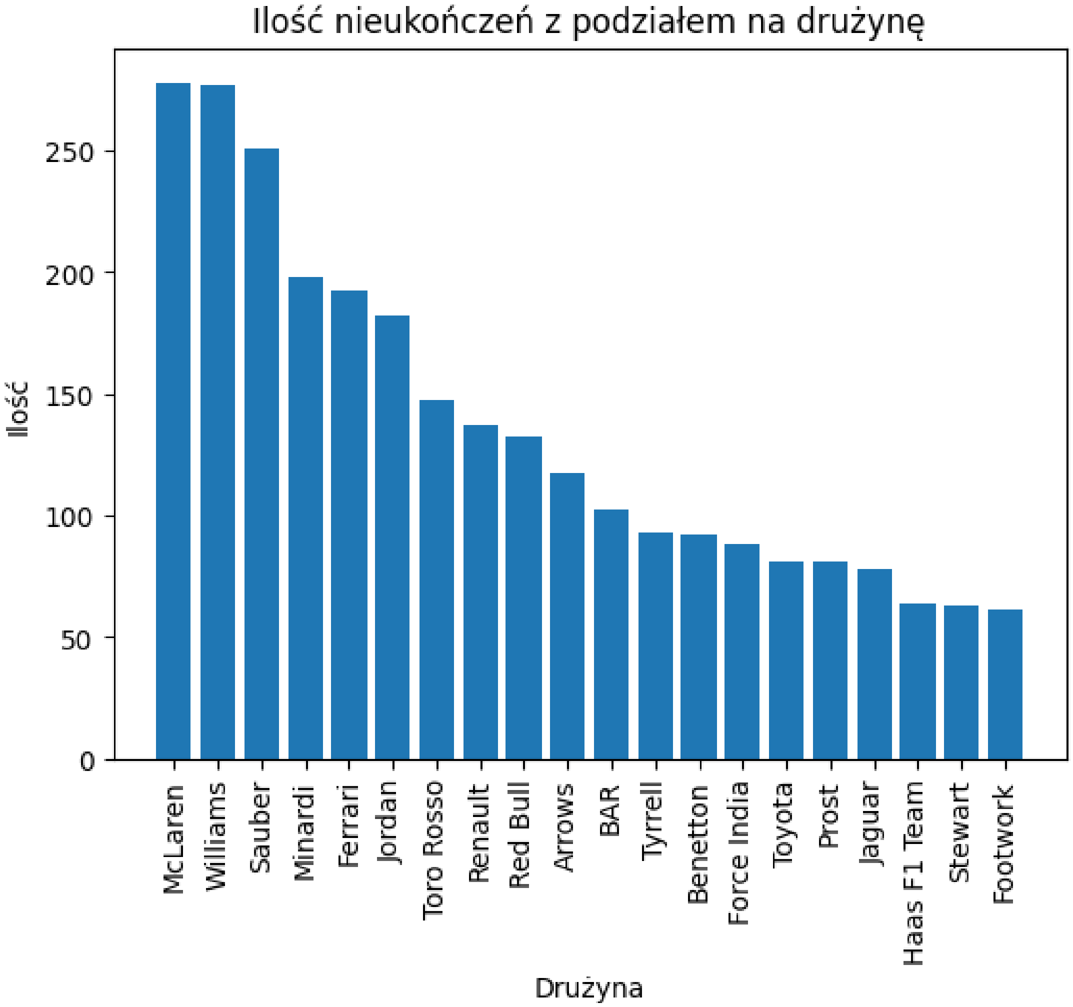


[ ]:

```
dnfs3 = df[~df["ending"].str.contains(r'\b(?:Lap|Laps|Finished)\b', case=False, regex=True)]['constructor_name']
dnfs3 = dnfs3.value_counts()
dnfs3 = pd.DataFrame({'constructor_name': dnfs3.index, 'num of dnfs': dnfs3.values})
print(dnfs3)
plt.bar(dnfs3['constructor_name'][:20], dnfs3['num of dnfs'][:20])
plt.title("Ilość nieukończeń z podziałem na drużynę")
plt.xlabel("Drużyna")
plt.xticks(rotation=90)
plt.ylabel("Ilość")
plt.show()
```

```
   constructor_name  num of dnfs
0           McLaren          278
1          Williams          277
2            Sauber          251
3           Minardi          198
4           Ferrari          192
5            Jordan          182
6        Toro Rosso          147
7           Renault          137
8          Red Bull          132
9            Arrows          117
10              BAR          102
11          Tyrrell           93
12         Benetton           92
13      Force India           88
14           Toyota           81
15            Prost           81
16           Jaguar           78
17     Haas F1 Team           64
18          Stewart           63
19         Footwork           61
20          Pacific           60
21         Mercedes           51
22         Lotus F1           42
23            Forti           39
24           Ligier           38
25              HRT           36
26      Super Aguri           32
27            Lotus           26
28           Virgin           25
29           Simtek           25
30            Honda           25
31         Caterham           25
32       BMW Sauber           23
```

```
33        Alfa Romeo            22
34        AlphaTauri            22
35         Larrousse            20
36          Marussia            17
37            Spyker            16
38      Aston Martin            14
39        Team Lotus            13
40      Racing Point            13
41    Alpine F1 Team            13
42    Manor Marussia            12
43               MF1            12
44        Spyker MF1             3
45             Brawn             2
46              Lola             2
```

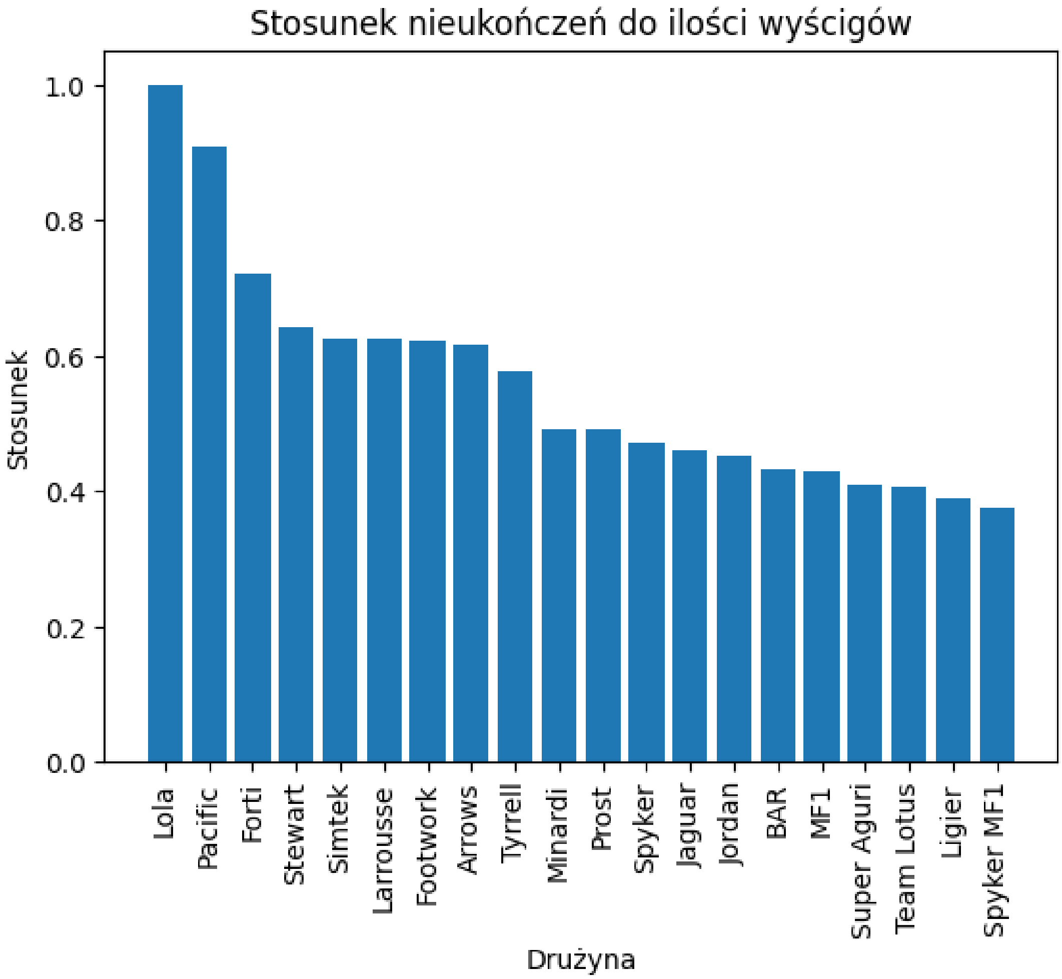


14 Czy jest to dobra reprezentacja danych?

```
[ ]: constructors_num = df['constructor_name'].value_counts()
     constructors = pd.DataFrame({'constructor_name': constructors_num.index,␣
      ↪'number of races': constructors_num.values})
     constructors_merged = pd.merge(dnfs3, constructors, on='constructor_name')
     print(constructors_merged)
     final_data = pd.DataFrame({'constructor_name':␣
      ↪constructors_merged['constructor_name'], 'ratio': constructors_merged['num␣
      ↪of dnfs'] / constructors_merged['number of races']})
     final_data = final_data.sort_values(by='ratio', ascending=False)
     plt.bar(final_data['constructor_name'][:20], final_data['ratio'][:20])
     plt.xticks(rotation=90)
     plt.title("Stosunek nieukończeń do ilości wyścigów")
     plt.xlabel("Drużyna")
     plt.ylabel("Stosunek")
     plt.show()
```

```
   constructor_name  num of dnfs  number of races
0           McLaren          278             1062
1          Williams          277             1061
2            Sauber          251              757
3           Minardi          198              402
4           Ferrari          192             1062
5            Jordan          182              404
6        Toro Rosso          147              536
7           Renault          137              556
8          Red Bull          132              696
9            Arrows          117              190
10              BAR          102              236
11          Tyrrell           93              161
12         Benetton           92              264
13      Force India           88              424
14           Toyota           81              280
15            Prost           81              165
16           Jaguar           78              170
17     Haas F1 Team           64              288
18          Stewart           63               98
19         Footwork           61               98
20          Pacific           60               66
21         Mercedes           51              518
22          Lotus F1           42              154
23            Forti           39               54
24          Ligier           38               98
25              HRT           36              116
26      Super Aguri           32               78
27            Lotus           26               76
```

```
28          Virgin          25          76
29          Simtek          25          40
30           Honda          25         106
31        Caterham          25         112
32      BMW Sauber          23         140
33      Alfa Romeo          22         164
34      AlphaTauri          22         122
35       Larrousse          20          32
36        Marussia          17         109
37          Spyker          16          34
38    Aston Martin          14          88
39      Team Lotus          13          32
40    Racing Point          13          76
41  Alpine F1 Team          13          88
42  Manor Marussia          12          78
43             MF1          12          28
44      Spyker MF1           3           8
45           Brawn           2          34
46            Lola           2           2
```


Stosunek nieukończeń do ilości wyścigów
Stosunek
Lola
Pacific
Forti
Stewart
Simtek
Larrousse
Footwork
Arrows
Tyrrell
Minardi
Prost
Spyker
Jaguar
Jordan
BAR
MF1
Super Aguri
Team Lotus
Ligier
Spyker MF1
Drużyna