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ФАКУЛЬТЕТ **ИНФОРМАТИКА И СИСТЕМЫ УПРАВЛЕНИЯ**

ОТЧЕТ
по лабораторной работе № 1

Дисциплина: Технологии машинного обучения
Тема: «Разведочный анализ данных»

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Москва, 2023

Разведовочный анализ данных. Исследование и визуализация данных

1) Текстовое описание набора данных

В качестве исходного набора данных будем использовать данные о наиболее дорогиз футболистах за 2021 год. Задача является актуальной для специалистов трансферного рынгка ис портивных аналитиков.

Файл содержит следующие колонки:

- id - номер игрока в списке
- name - имя игрока
- position - позиция игрока на поле
- age - возраст игрока
- markey value in millions - рыночная стоимость игрока
- country - страна происхождения игрока
- club - клуб игрока
- matches - матчи, сыгранные в 2021 году
- goals - голы, забитые игроком в 2021 году
- own goals - автоголы, забитые игроком в 2021 году
- assists - голы, забитые с паса игрока
- yellow cards - число полученных желтых карточек
- second yellow cards - число полученных вторых желтых карточек
- red cards - число полученных красных карточек
- Number Of Substitute In - число замен при входе в игру
- Number Of Substitute Out - число замен на выход из игры

Импорт библиотек

Импортируем библиотеки с помощью команды import.

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
sns.set(style="ticks")
```

Загрузка данных

Загрузим файл датасета с помощью библиотеки Pandas.

```
df = pd.read_csv('players.csv')
```

2) Основные характеристики датасета

```
#вывод первых 5 строк
df.head()
```

```
   Unnamed: 0            Name        Position  Age  \
0           0   Kylian Mbappé  Centre-Forward   22   
1           1  Erling Haaland  Centre-Forward   21   
2           2      Harry Kane  Centre-Forward   28   
3           3   Jack Grealish     Left Winger   26   
4           4   Mohamed Salah    Right Winger   29   

   Markey Value In Millions(£)  Country                 Club  Matches  
Goals  \
0                        144.0   France  Paris Saint-Germain       16   
7   
1                        135.0   Norway    Borussia Dortmund       10   
13   
2                        108.0  England    Tottenham Hotspur       16   
7   
3                         90.0  England      Manchester City       15   
2   
4                         90.0    Egypt         Liverpool FC       15   
15   

   Own Goals  Assists  Yellow Cards  Second Yellow Cards  Red Cards  \
0          0       11             3                    0          0   
1          0        4             1                    0          0   
2          0        2             2                    0          0   
3          0        3             1                    0          0   
4          0        6             1                    0          0   

   Number Of Substitute In  Number Of Substitute Out  
0                        0                         8  
1                        0                         1  
2                        2                         2  
3                        2                         8  
4                        0                         3  
```

```
#Определение размера датасета
df.shape
```

```
(500, 16)
```

Размер датасета 500 строк, 16 столбцов

```
total_count = df.shape[0]
print('Всего строк: {}'.format(total_count))
```

```
Всего строк: 500
```

```
total_count = df.shape[1]
print('Всего колонок: {}'.format(total_count))
```

```
Всего колонок: 16
```

```
#Список колонок
df.columns
```

```
Index(['Unnamed: 0', 'Name', 'Position', 'Age', 'Markey Value In
Millions(£)',
       'Country', 'Club', 'Matches', 'Goals', 'Own Goals', 'Assists',
       'Yellow Cards', 'Second Yellow Cards', 'Red Cards',
       'Number Of Substitute In', 'Number Of Substitute Out'],
      dtype='object')
```

```
#Список колонок и тип данных
df.dtypes
```

```
Unnamed: 0                         int64
Name                              object
Position                          object
Age                                int64
Markey Value In Millions(£)      float64
Country                           object
Club                              object
Matches                            int64
Goals                              int64
Own Goals                          int64
Assists                            int64
Yellow Cards                       int64
Second Yellow Cards                int64
Red Cards                          int64
Number Of Substitute In            int64
Number Of Substitute Out           int64
dtype: object
```

```
# Проверим наличие пустых значений
# Цикл по колонкам датасета
for col in df.columns:
    # Количество пустых значений - все значения заполнены
    temp_null_count = df[df[col].isnull()].shape[0]
    print('{} - {}'.format(col, temp_null_count))
```

```
Unnamed: 0 - 0
Name - 0
```

```
Position - 0
Age - 0
Markey Value In Millions(£) - 0
Country - 0
Club - 0
Matches - 0
Goals - 0
Own Goals - 0
Assists - 0
Yellow Cards - 0
Second Yellow Cards - 0
Red Cards - 0
Number Of Substitute In - 0
Number Of Substitute Out - 0
```

```
# Основные статистические характеристки набора данных
df.describe()
```

```
       Unnamed: 0         Age  Markey Value In Millions(£)     Matches
\
count  500.000000  500.000000                   500.000000  500.000000

mean   249.500000   24.968000                    31.537800   12.396000

std    144.481833    3.165916                    17.577697    4.342453

min      0.000000   16.000000                    16.200000    0.000000

25%    124.750000   23.000000                    19.800000   10.000000

50%    249.500000   25.000000                    25.200000   13.000000

75%    374.250000   27.000000                    36.000000   16.000000

max    499.000000   36.000000                   144.000000   24.000000


            Goals   Own Goals    Assists  Yellow Cards  Second Yellow
Cards  \
count  500.000000  500.000000  500.00000    500.000000
500.000000
mean     2.160000    0.030000    1.51200      1.592000
0.036000
std      2.880102    0.170758    1.85276      1.445585
0.186477
min      0.000000    0.000000    0.00000      0.000000
0.000000
25%      0.000000    0.000000    0.00000      0.000000
0.000000
50%      1.000000    0.000000    1.00000      1.000000
```

```
0.000000
75%      3.000000    0.000000    2.00000      2.000000
0.000000
max     23.000000    1.000000   12.00000      7.000000
1.000000

        Red Cards  Number Of Substitute In  Number Of Substitute Out
count  500.000000               500.000000                500.000000
mean     0.046000                 2.394000                  3.744000
std      0.209695                 2.517825                  3.293046
min      0.000000                 0.000000                  0.000000
25%      0.000000                 0.000000                  1.000000
50%      0.000000                 2.000000                  3.000000
75%      0.000000                 3.250000                  6.000000
max      1.000000                13.000000                 20.000000
```

```
# Определим уникальные значения для целевого признака
df['Name'].unique()
```

```
array(['Kylian Mbappé', 'Erling Haaland', 'Harry Kane', 'Jack 
Grealish',
       'Mohamed Salah', 'Romelu Lukaku', 'Kevin De Bruyne', 'Neymar',
       'Jadon Sancho', 'Frenkie de Jong', 'Bruno Fernandes',
       'Joshua Kimmich', 'Raheem Sterling', 'Marcus Rashford',
       'Sadio Mané', 'Heung-min Son', 'Pedri', 'Phil Foden',
       'Lautaro Martínez', 'Marcos Llorente', 'Lionel Messi',
       'Mason Mount', 'Trent Alexander-Arnold', 'Rúben Dias',
       'Marquinhos', 'Jude Bellingham', 'João Félix', 'Alphonso 
Davies',
       'Achraf Hakimi', 'Declan Rice', 'Rodri', 'Mikel Oyarzabal',
       'Federico Chiesa', 'Matthijs de Ligt', 'Kai Havertz',
       'Sergej Milinković-Savić', 'Bernardo Silva', 'Raphaël Varane',
       'Serge Gnabry', 'Leon Goretzka', 'Jan Oblak', 'Casemiro',
       'Florian Wirtz', 'Bukayo Saka', 'Federico Valverde',
       'Gianluigi Donnarumma', 'Nicolò Barella', 'Andrew Robertson',
       'Ansu Fati', 'Jules Koundé', 'Victor Osimhen', 'Gabriel Jesus',
       'Dayot Upamecano', 'Alessandro Bastoni', 'Wilfred Ndidi',
       'José María Giménez', 'Fabinho', 'Milan Skriniar', 'Leroy 
Sané',
       'Paul Pogba', 'Thibaut Courtois', 'Alisson', 'Koke',
       'Robert Lewandowski', 'Eduardo Camavinga', 'Richarlison',
       'Franck Kessié', 'Youri Tielemans', 'Kingsley Coman',
       "N'Golo Kanté", 'João Cancelo', 'Timo Werner', 'Virgil van 
Dijk',
       'Marco Verratti', 'Marc-André ter Stegen', 'David Alaba',
       'Jamal Musiala', 'Mason Greenwood', 'Pau Torres', 'Ferran 
Torres',
       'Vinícius Júnior', 'Dušan Vlahovic', 'Theo Hernández',
       'Christian Pulisic', 'James Maddison', 'Dani Olmo',
       'Ferland Mendy', 'Ousmane Dembélé', 'Ederson', 'Paulo Dybala',
       'Piotr Zielinski', 'Harry Maguire', 'Antoine Griezmann',
       'Stefan de Vrij', 'Lorenzo Insigne', 'Kalidou Koulibaly',
       'Christopher Nkunku', 'Reece James', 'Tanguy Ndombélé',
       'Fabián Ruiz', 'Diogo Jota', 'Diego Carlos', 'Caglar Söyüncü',
       'Hirving Lozano', 'Dominic Calvert-Lewin', 'Lorenzo
Pellegrini',
       'Lucas Hernández', 'Aymeric Laporte', 'Memphis Depay',
       'Wilfried Zaha', 'Álvaro Morata', 'Jorginho', 'Mateo Kovacic',
       'Cristiano Ronaldo', 'Giovanni Reyna', 'Moussa Diaby',
       'Tomas Soucek', 'Rúben Neves', 'Luke Shaw', 'Riyad Mahrez',
       'Nuno Mendes', 'Edmond Tapsoba', 'Aaron Wan-Bissaka',
       'Wesley Fofana', 'Youssef En-Nesyri', 'Éder Militão',
       'Nicolò Zaniolo', 'Carlos Soler', 'Kalvin Phillips',
       'Alexander Isak', 'Mikel Merino', 'Ben White', 'Martin
Ødegaard',
       'Fikayo Tomori', 'Presnel Kimpembe', 'Ángel Correa',
       'Rodrigo de Paul', 'Thomas Partey', 'Thomas Lemar', 'André
Silva',
       'Gerard Moreno', 'Raphaël Guerreiro', 'Pierre-Emile Höjbjerg',
       'Marcelo Brozovic', 'Saúl Ñíguez', 'Yannick Carrasco',
       'Roberto Firmino', 'Luis Alberto', 'Ilkay Gündogan',
       'Ismaël Bennacer', 'Tammy Abraham', 'Ben Chilwell', 'Hakim
Ziyech',
       'Ciro Immobile', 'Jonathan David', 'Pedro Neto', 'Douglas
Luiz',
       'Lucas Paquetá', 'Dejan Kulusevski', 'Amine Gouiri',
       'Aurélien Tchouaméni', 'Rodrygo', 'Harvey Barnes', 'Houssem
Aouar',
       'Leon Bailey', 'Moise Kean', 'Arthur', 'Ibrahima Konaté',
       'Cristian Romero', 'Benjamin Pavard', 'Nicolas Pépé',
       'Emiliano Buendía', 'Scott McTominay', 'Marco Asensio',
       'Mario Hermoso', 'Angeliño', 'Robin Gosens', 'Manuel
Locatelli',
       'José Gayà', 'Andreas Christensen', 'Anthony Martial',
       'Domenico Berardi', 'Andrea Belotti', 'Niklas Süle',
       'Wissam Ben Yedder', 'Lucas Digne', 'Emiliano Martínez',
       'Antonio Rüdiger', 'Mauro Icardi', 'Ryan Gravenberch',
       'Jordan Veretout', 'Duván Zapata', 'Raphinha',
       'Callum Hudson-Odoi', 'Davinson Sánchez', 'Ollie Watkins',
       'Naby Keïta', 'Kieran Tierney', 'Ivan Toney', 'Ante Rebic',
       'James Ward-Prowse', 'Nathan Aké', 'Kurt Zouma', 'Marcel
Sabitzer',
       'Yéremy Pino', 'Bryan Gil', 'Bruno Guimarães', 'Matheus Cunha',
       'Edouard Mendy', 'Curtis Jones', 'Sergiño Dest',
       'Rodrigo Bentancur', 'Donyell Malen', 'Jarrod Bowen',
       'Nikola Vlasic', 'Manuel Akanji', 'Allan Saint-Maximin',
       'Joan Jordán', 'Renato Sanches', 'Gianluca Mancini', 'Joe
Gomez',
       'Tyrone Mings', 'Wout Weghorst', 'Joaquín Correa',
       'Ricardo Pereira', 'Dele Alli', 'Ruslan Malinovskyi',
       'Adama Traoré', 'John McGinn', 'Lucas Ocampos', 'John Stones',
       'Adrien Rabiot', 'Leander Dendoncker', 'Matteo Politano',
       'Hakan Calhanoglu', 'Jesús Corona', 'Luis Muriel', 'Kevin
Volland',
       'Thomas Müller', 'Georginio Wijnaldum', 'Toni Kroos',
       'Benoît Badiashile', 'Maxence Lacroix', 'Boubacar Kamara',
       'Emile Smith Rowe', "Evan N'Dicka", 'Sven Botman',
       'Boubakary Soumaré', 'Merih Demiral', 'Marcus Thuram',
       'Florian Neuhaus', 'Aleksandr Golovin', 'Timothy Castagne',
       'Patrik Schick', 'Nélson Semedo', 'Raúl Jiménez',
       'Oleksandr Zinchenko', 'Kyle Walker', 'Ismaïla Sarr',
       'Sandro Tonali', 'Denis Zakaria', 'Xaver Schlager',
       'Lukas Klostermann', 'Sébastien Haller', 'Matthias Ginter',
       'Thorgan Hazard', 'Jérémy Doku', 'Gabriel Barbosa',
       'Konrad Laimer', 'Emre Can', 'Leonardo Spinazzola', 'Gavi',
       'Ilaix Moriba', 'Silas Katompa Mvumpa', 'Antony', 'Roger
Ibañez',
       'Fábio Silva', 'Lisandro Martínez', 'Luis Díaz', 'Ronald
Araújo',
       'Renan Lodi', 'Emerson Royal', 'Dominik Szoboszlai',
       'Charles De Ketelaere', 'Gabriel', 'Pedro Gonçalves',
       'Nikola Milenkovic', 'Ezri Konsa', 'Yves Bissouma', 'Maxi
Gómez',
       'Rafael Leão', 'Daichi Kamada', 'Arnaut Danjuma',
       'André Zambo Anguissa', 'Robin Le Normand', 'Nordi Mukiele',
       'Ben Godfrey', 'Noa Lang', 'Weston McKennie', 'Ridle Baku',
       'Jonathan Ikoné', 'Jonathan Bamba', 'Saïd Benrahma',
       'Donny van de Beek', 'Sergio Reguilón', 'Jason Denayer',
       'Viktor Tsygankov', 'Davide Calabria', 'Daniel Podence',
       'Iñaki Williams', 'Jan Bednarek', 'Abdou Diallo', 'Thilo
Kehrer',
       'Gonçalo Guedes', 'Nabil Fekir', 'Nico Elvedi', 'Mike Maignan',
       'Sardar Azmoun', 'James Tarkowski', 'Iñigo Martínez',
       'Remo Freuler', 'Lewis Dunk', 'Daniel Carvajal', 'Jordan
Pickford',
       'Conor Coady', 'Abdoulaye Doucouré', 'Michael Keane',
       'Stefan Savic', 'Lucas Moura', 'Pablo Sarabia', 'Thiago',
       'Pierre-Emerick Aubameyang', 'Eden Hazard', 'Karim Benzema',
       'Nicolás González', 'Amadou Haidara', 'Rafa Silva', 'Otávio',
       'Victor Lindelöf', 'Giovanni Di Lorenzo', 'Odilon Kossounou',
       'Rayan Cherki', 'Brahim Díaz', 'Mario Pasalic', 'Marten de
Roon',
       'Andrej Kramaric', 'Gabriel Martinelli', 'Dwight McNeil',
       'Max Aarons', 'David Neres', 'Mattéo Guendouzi', 'Cody Gakpo',
       'Matty Cash', 'Francisco Trincão', 'Marash Kumbulla',
       'Sasa Kalajdzic', 'Patson Daka', 'Giovani Lo Celso',
       'Guido Rodríguez', 'Joe Willock', 'Todd Cantwell',
       'Christoph Baumgartner', 'Malcom', 'Orel Mangala',
       'Ramy Bensebaini', 'Steven Bergwijn', 'Kasper Dolberg',
       'Paul Onuachu', 'Joachim Andersen', 'Dean Henderson', 'Alex
```

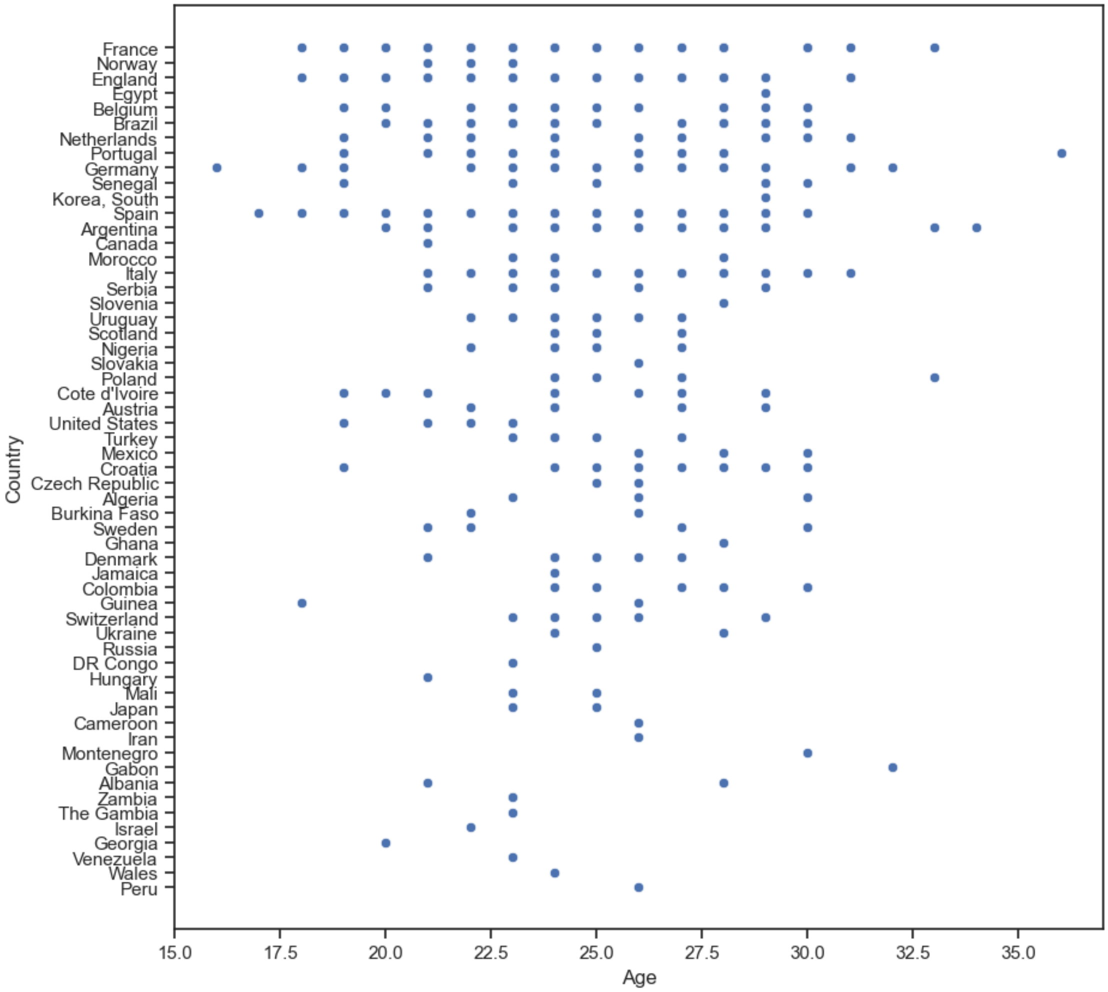
```
Iwobi',
       'Jonathan Tah', 'Alejandro Grimaldo', 'Fred', 'Patrick
Bamford',
       'Eric Dier', 'Leandro Paredes', 'Berat Djimsiti', 'Jesse
Lingard',
       'Danny Ings', 'Allan', 'Callum Wilson', 'Granit Xhaka',
       'Alexandre Lacazette', 'João Palhinha', 'Yussuf Poulsen',
       'Thiago Almada', 'Julián Álvarez', 'Sofiane Diop', 'Pape Sarr',
       'Pedro Porro', 'Darwin Núñez', 'Illan Meslier', 'Mikkel
Damsgaard',
       'Karim Adeyemi', 'Enock Mwepu', 'Musa Barrow', 'Eberechi Eze',
       'Eric García', 'Aaron Ramsdale', 'Martín Zubimendi',
       'Samuel Chukwueze', 'Dodô', 'Manor Solomon', 'Marc Guehi',
       'Hamed Junior Traorè', 'Yusuf Yazici', 'Tetê', 'Pablo Fornals',
       'Alfonso Pedraza', 'Igor Zubeldia', 'Mason Holgate', 'Ché
Adams',
       'Gerson', 'Tyler Adams', 'Matteo Pessina', 'Takehiro Tomiyasu',
       'Jeff Reine-Adélaïde', 'Dani Ceballos', 'Nahitan Nández',
       'Gaetano Castrovilli', 'Kelechi Iheanacho', 'Mauro Arambarri',
       'Yerry Mina', 'Marc Cucurella', 'Unai Simón', 'Luka Jovic',
       'Alex Telles', 'Yeray Álvarez', 'Zeki Celik', 'Harry Winks',
       'Diego Llorente', 'Juan Musso', 'Moussa Dembélé', 'André
Gomes',
       'Neal Maupay', 'Jérémie Boga', 'Álex Remiro', 'Bryan
Cristante',
       'Alessio Romagnoli', 'Julian Weigl', 'Arkadiusz Milik',
       'Héctor Bellerín', 'Julian Brandt', 'Tiemoué Bakayoko',
       'Filip Kostic', 'Danilo', 'Bertrand Traoré', 'Erik Lamela',
       'Emil Forsberg', 'Portu', 'Kieran Trippier', 'James Rodríguez',
       'Julian Draxler', 'Philippe Coutinho', 'Alex Sandro',
       'Sergio Canales', 'Jordan Henderson', 'Ángel Di María',
       'Josko Gvardiol', 'Joakim Maehle', 'Maximilian Arnold',
       'Mohamed Simakan', 'Rayan Aït Nouri', 'Amad Diallo',
       'Tariq Lamptey', 'Noni Madueke', 'Khvicha Kvaratskhelia',
'Wendel',
       'William Saliba', 'Marcos Senesi', 'Youssoufa Moukoko',
       'Luiz Felipe', 'Nicolás De La Cruz', 'Ryan Sessegnon',
       'Axel Disasi', 'Alexis Saelemaekers', 'Yangel Herrera',
       'Cengiz Ünder', 'Kyle Walker-Peters', 'Noussair Mazraoui',
       'Umar Sadiq', 'Sander Berge', 'Manuel Lazzari', 'Éverton',
       'Daniel James', 'Lucas Torreira', 'Tom Davies', 'Renato Tapia',
       'David Raya', 'Gregor Kobel', 'Wilmar Barrios', 'Gelson
Martins',
       'Rob Holding', 'Adam Armstrong', 'Giorgian de Arrascaeta',
       'Ayoze Pérez', 'Alex Meret', 'Duje Caleta-Car', 'Aritz
Elustondo'],
      dtype=object)
```

3) Визуальное исследование датасета

Диаграмма рассеиния

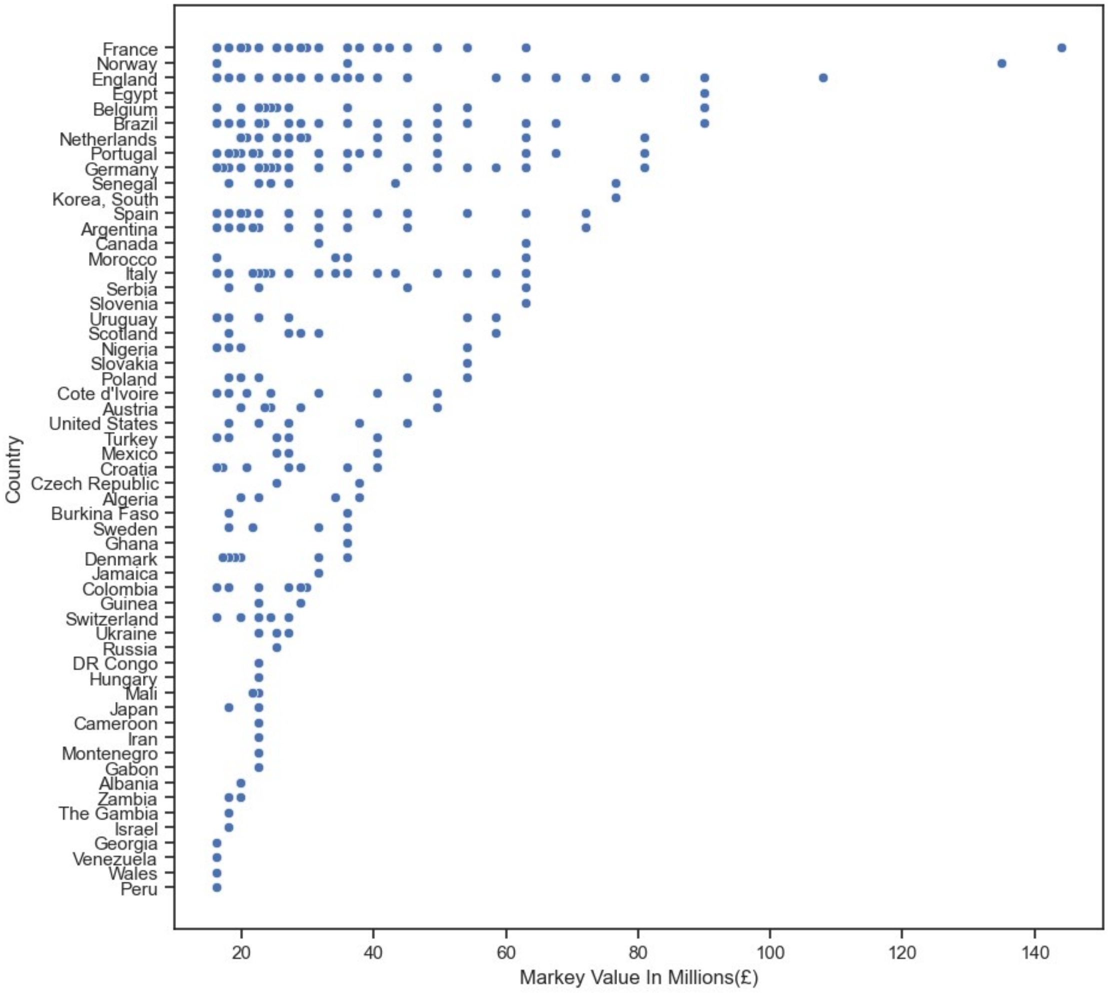
```
fig, ax = plt.subplots(figsize=(10,10))
sns.scatterplot(ax=ax, x='Age', y='Country', data=df)
```

```
<AxesSubplot: xlabel='Age', ylabel='Country'>
```



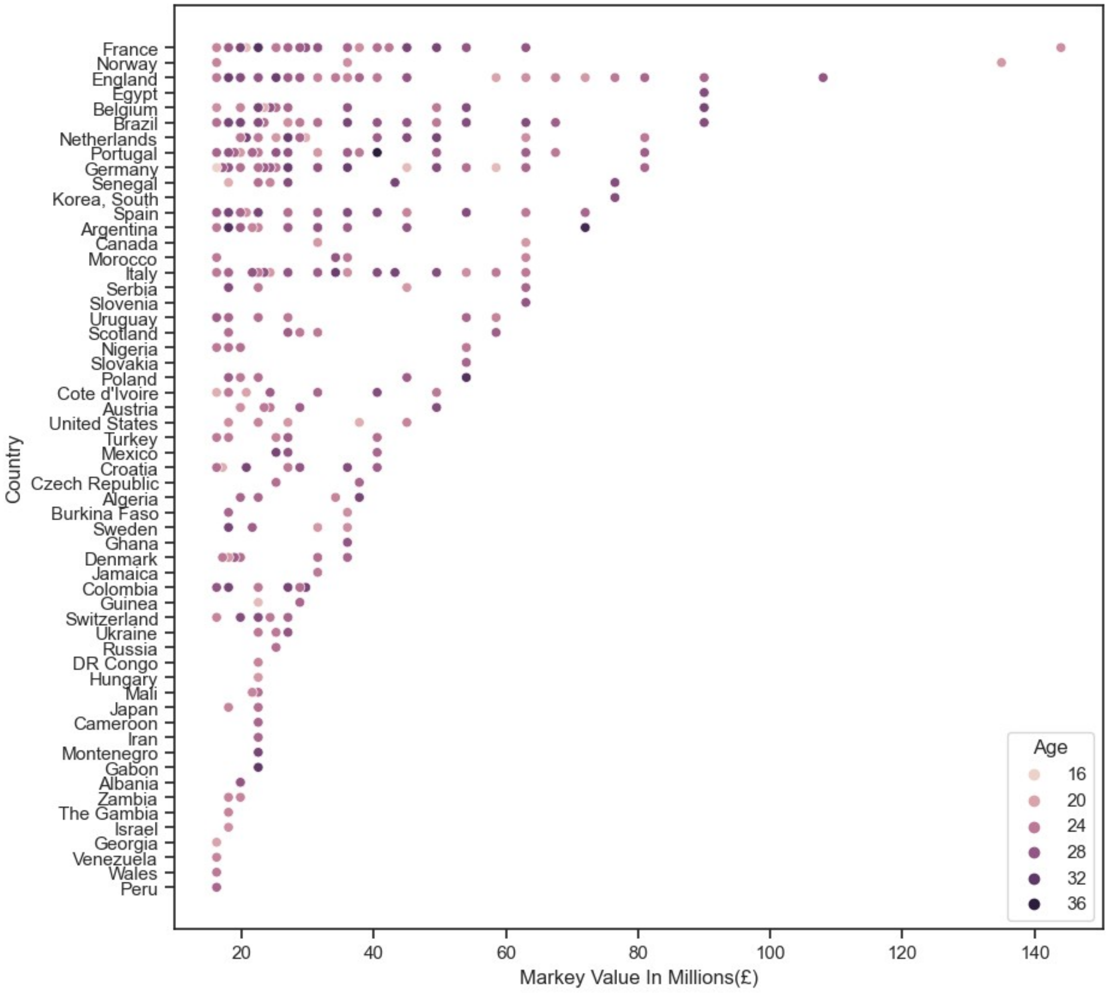
```
fig, ax = plt.subplots(figsize=(10,10))
sns.scatterplot(ax=ax, x='Markey Value In Millions(£)', y='Country',
data=df)
```

```
<AxesSubplot: xlabel='Markey Value In Millions(£)', ylabel='Country'>
```



```
fig, ax = plt.subplots(figsize=(10,10))
sns.scatterplot(ax=ax, x='Markey Value In Millions(£)', y='Country',
data=df, hue='Age')
```

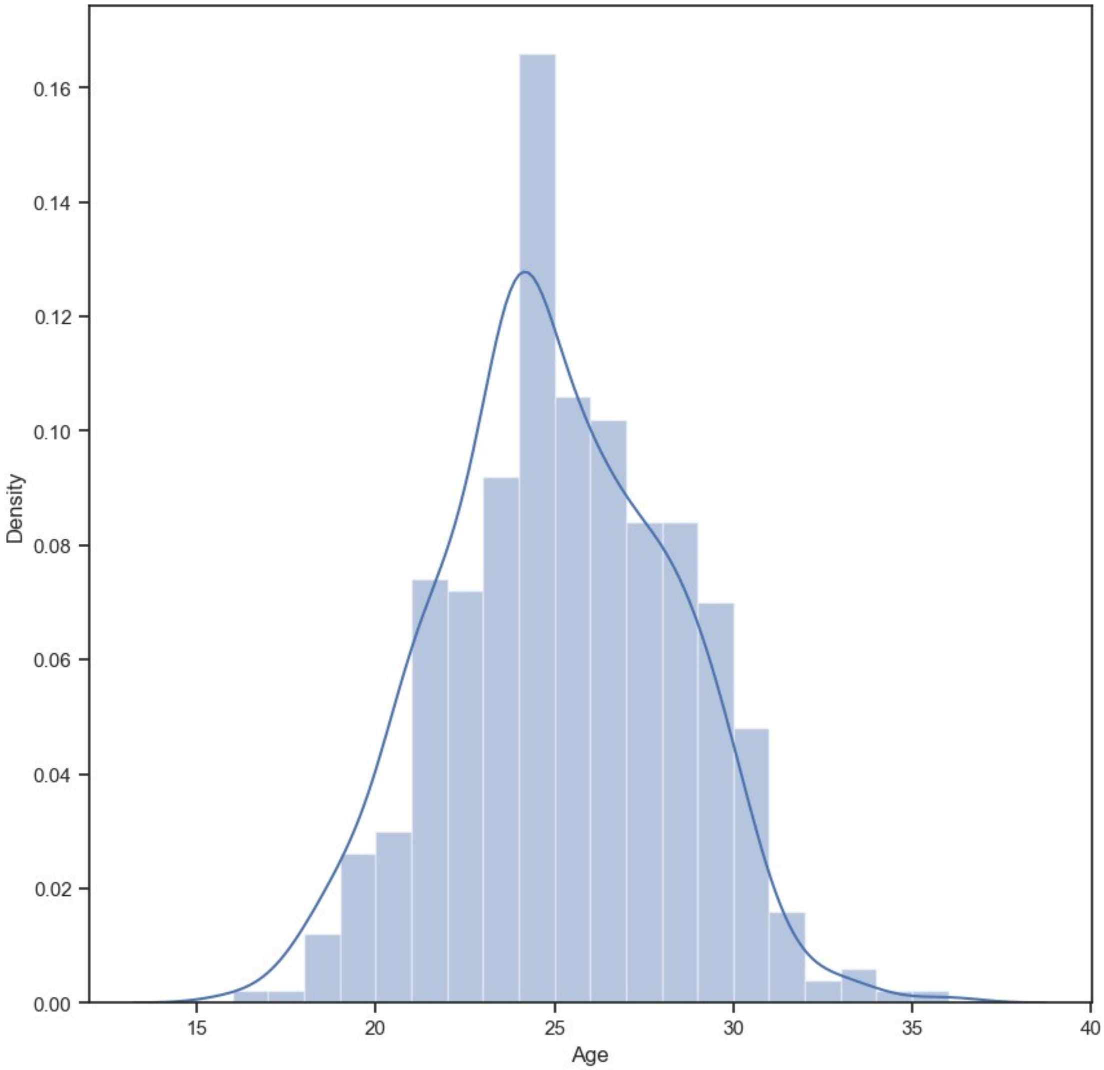
```
<AxesSubplot: xlabel='Markey Value In Millions(£)', ylabel='Country'>
```



```
fig, ax = plt.subplots(figsize=(10,10))
sns.distplot(df['Age'])
```

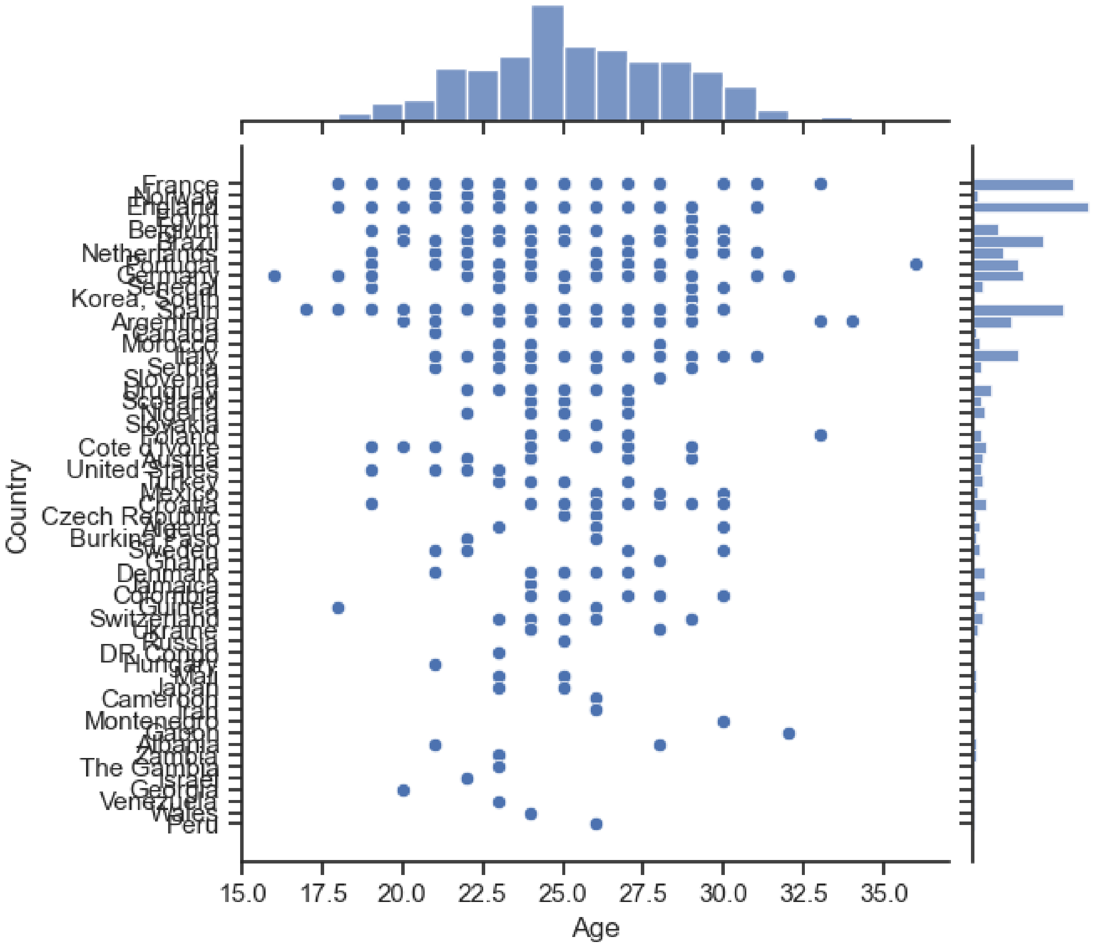
```
C:\Users\Артемий\AppData\Local\Temp\ipykernel_10120\2051692432.py:2:
UserWarning:

`distplot` is a deprecated function and will be removed in seaborn
v0.14.0.

Please adapt your code to use either `displot` (a figure-level
function with
similar flexibility) or `histplot` (an axes-level function for
histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df['Age'])
```

```
<AxesSubplot: xlabel='Age', ylabel='Density'>
```



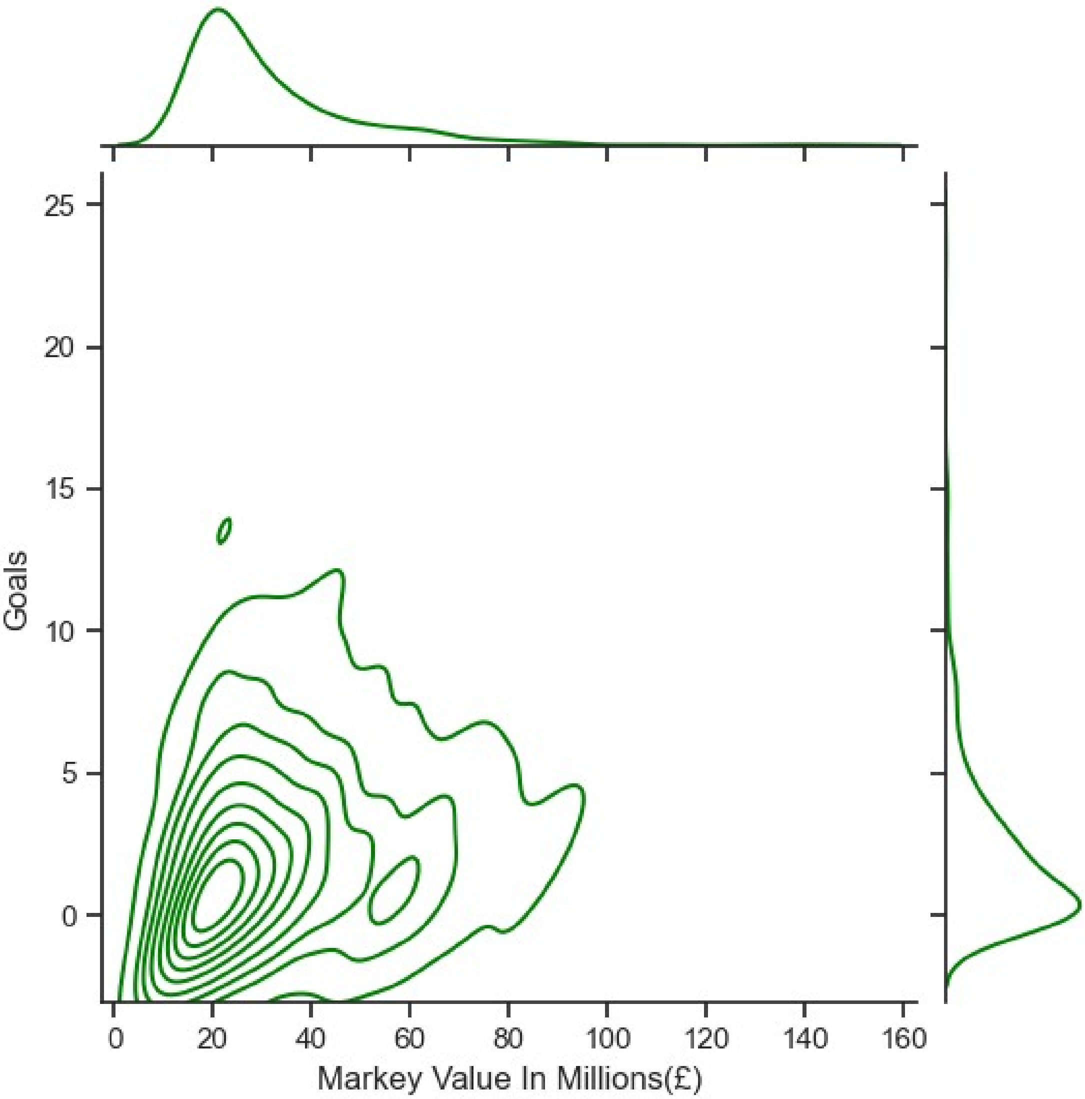
```
sns.jointplot(x='Age', y='Country', data=df)
```

```
<seaborn.axisgrid.JointGrid at 0x235782993d0>
```



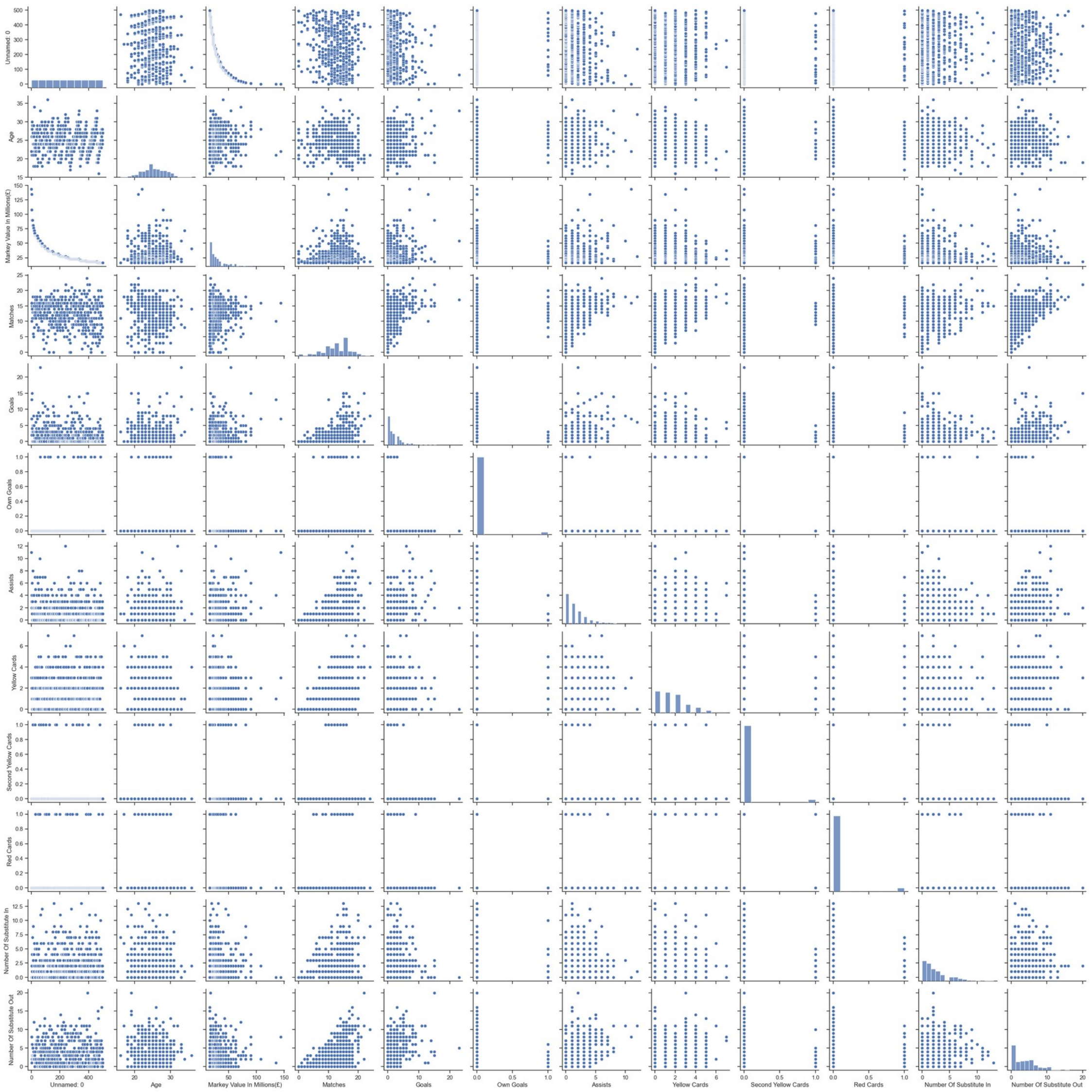
```
sns.jointplot(x='Markey Value In Millions(£)', y='Goals', data=df,
kind="kde", color='green')
```

```
<seaborn.axisgrid.JointGrid at 0x23578b25190>
```



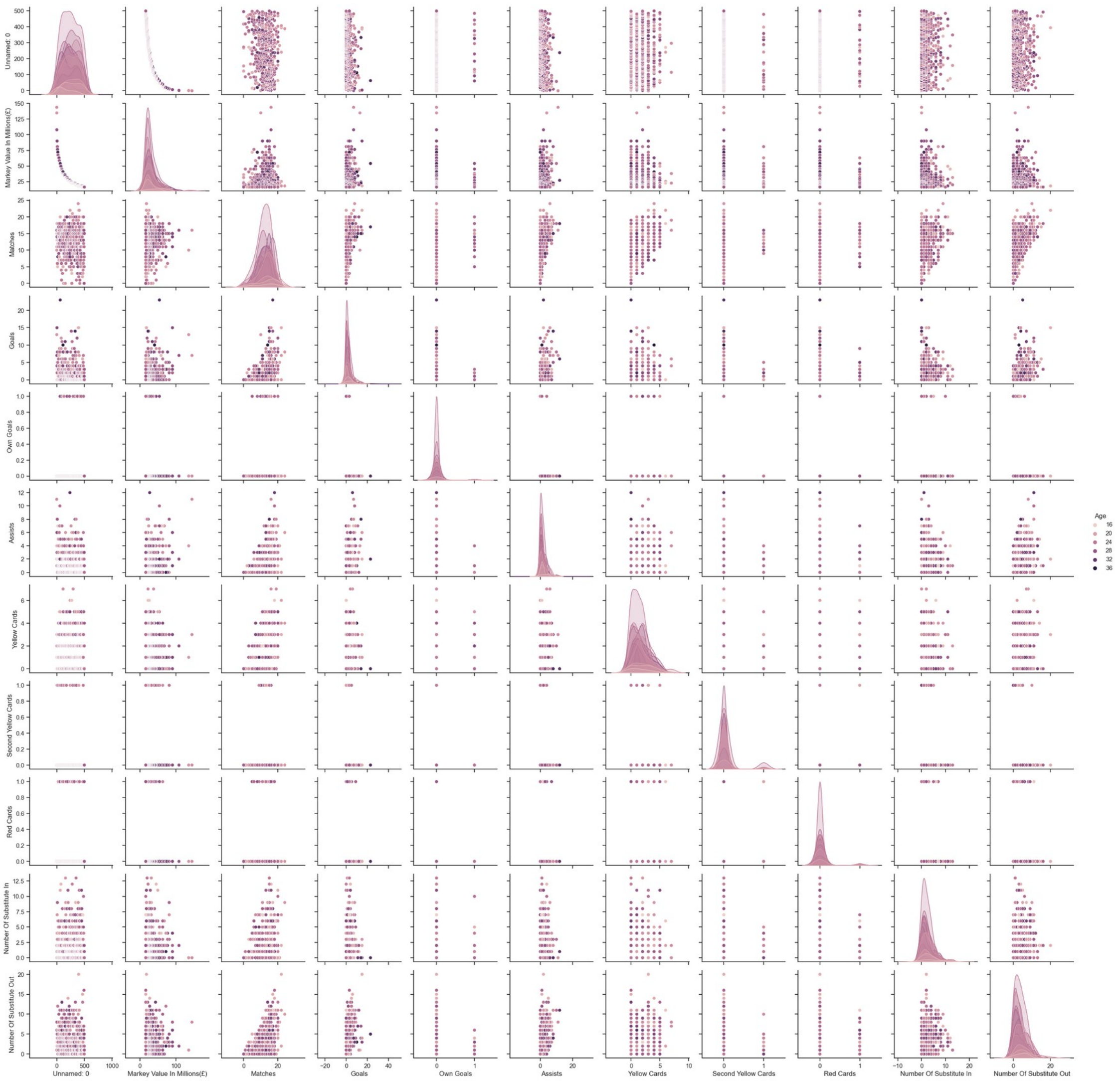
```
sns.pairplot(df)
```

```
<seaborn.axisgrid.PairGrid at 0x2356d60f310>
```



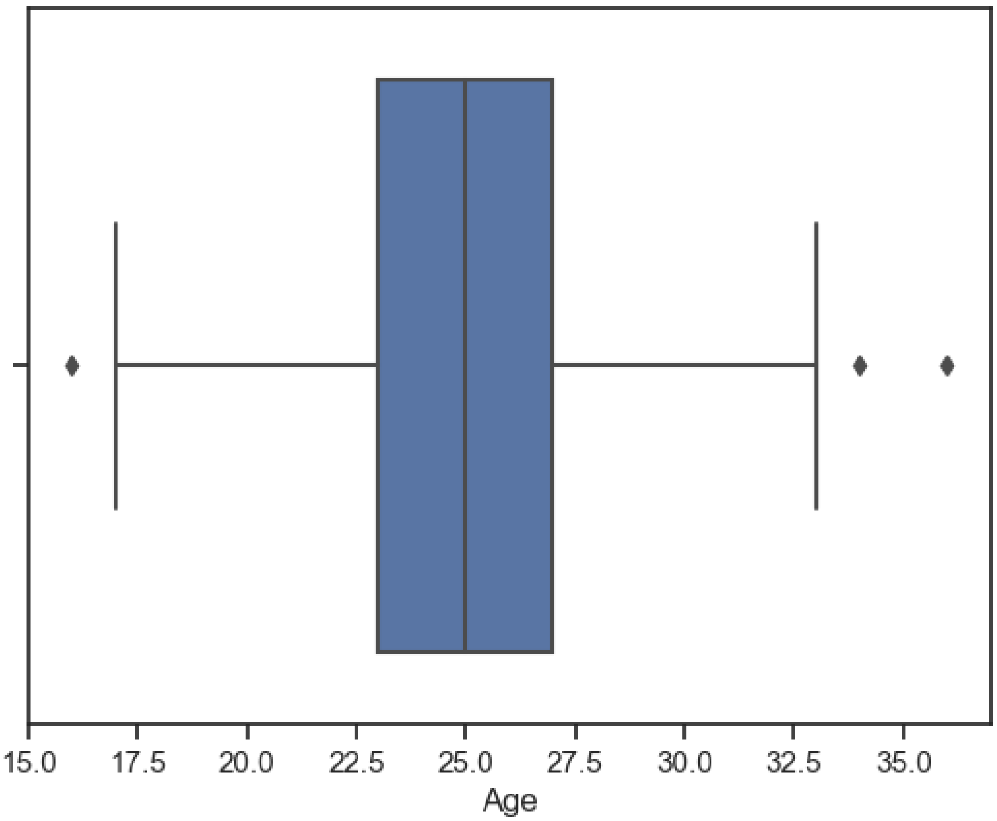
```
sns.pairplot(df, hue="Age")
```

```
<seaborn.axisgrid.PairGrid at 0x2357e6dfad0>
```



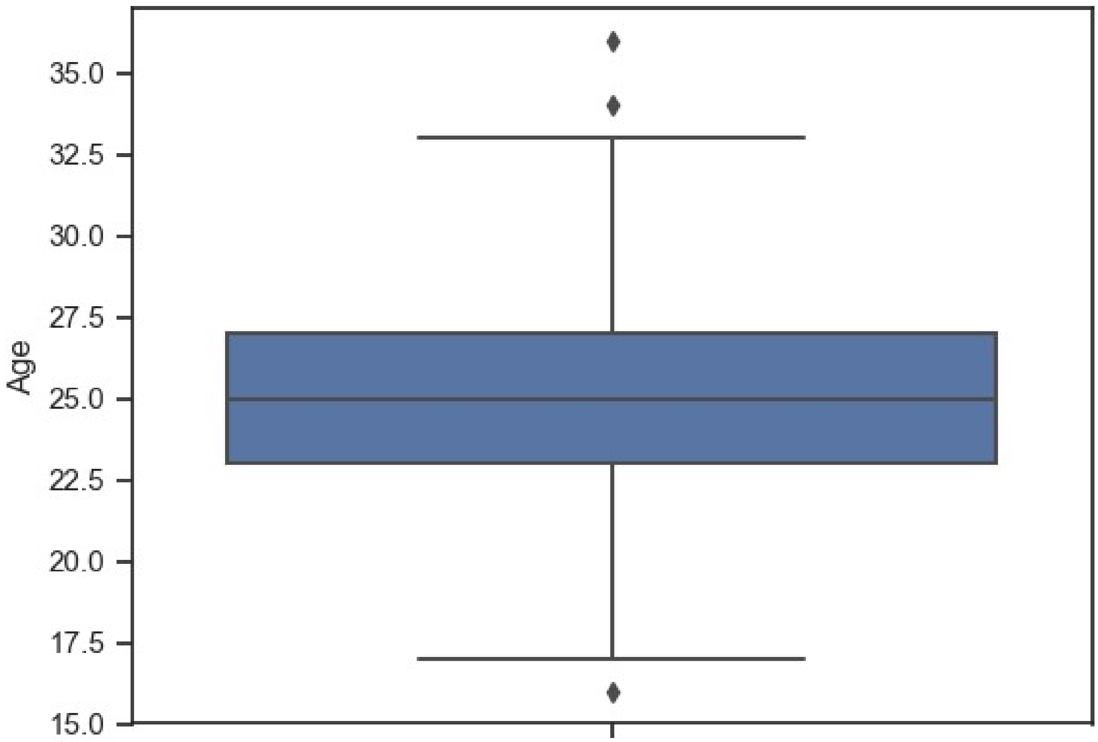
```
sns.boxplot(x=df['Age'])
```

```
<AxesSubplot: xlabel='Age'>
```



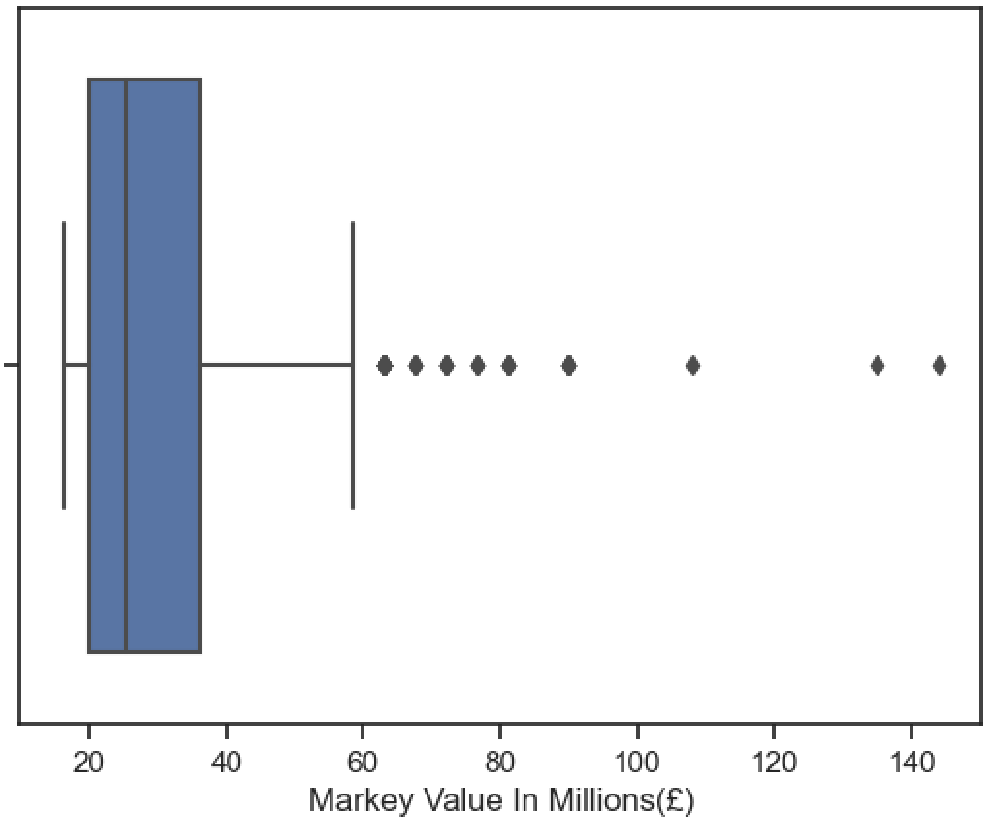
```
# По вертикали
sns.boxplot(y=df['Age'])
```

```
<AxesSubplot: ylabel='Age'>
```



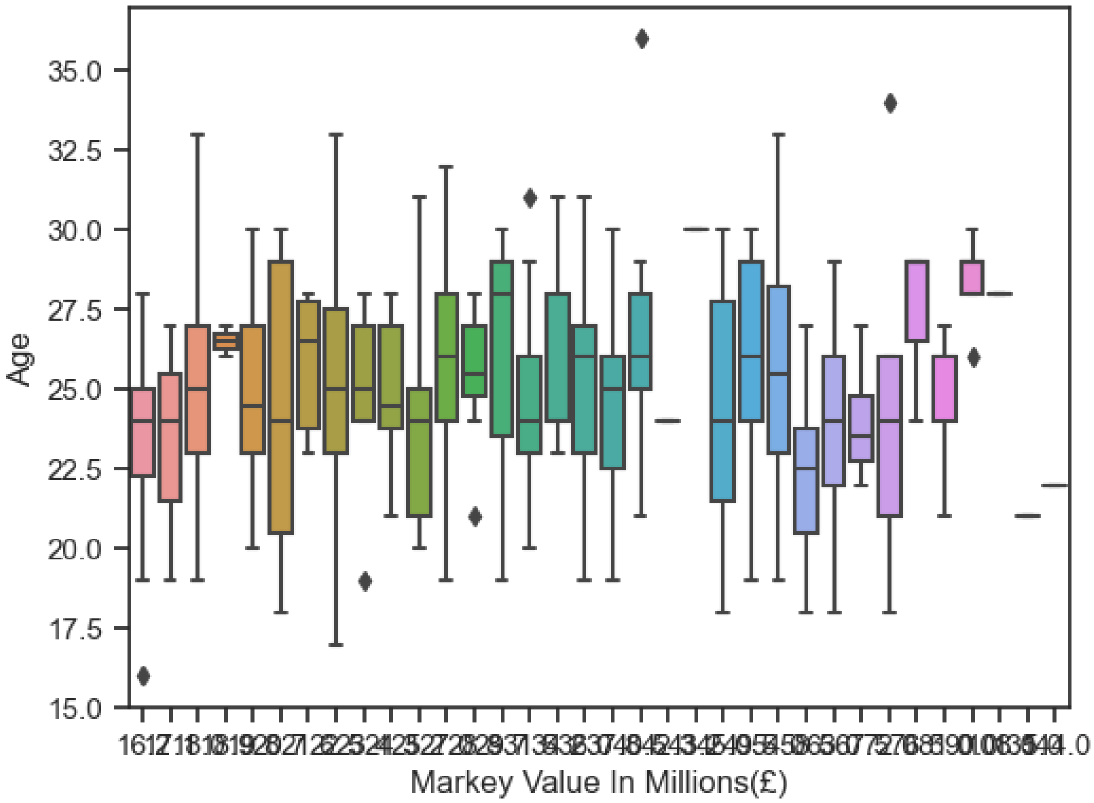
```
sns.boxplot(x=df['Markey Value In Millions(£)'])
```

```
<AxesSubplot: xlabel='Markey Value In Millions(£)'>
```



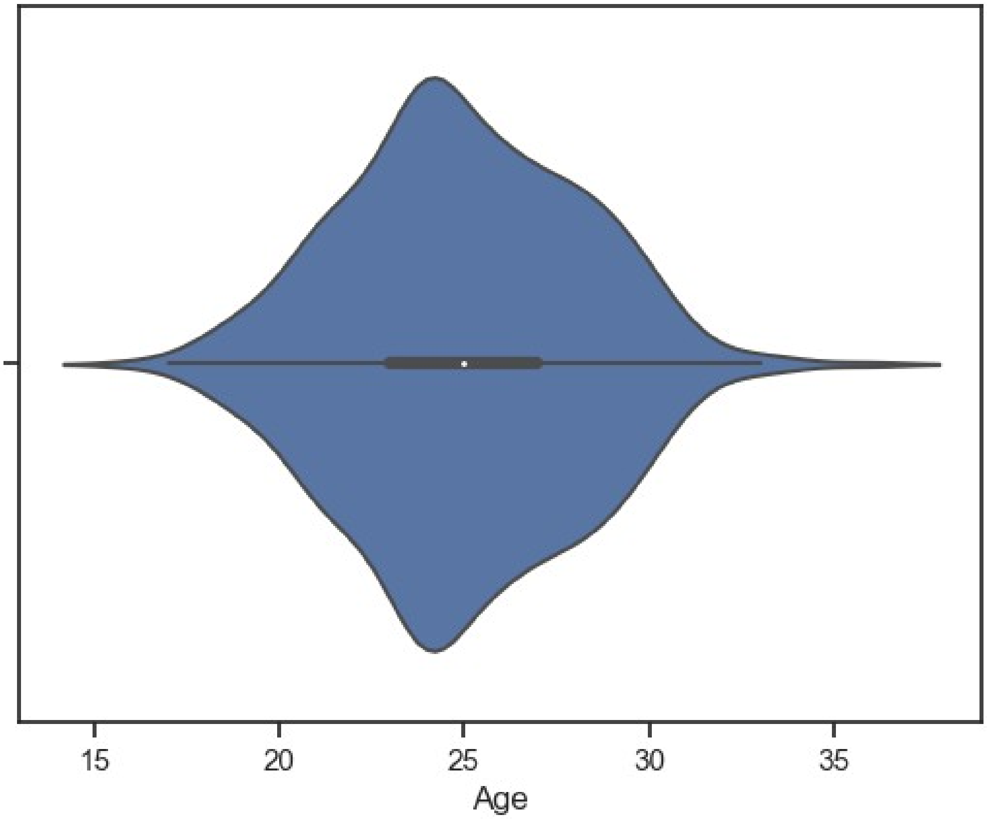
```
# Распределение параметра Humidity сгруппированные по Occupancy.
sns.boxplot(x='Markey Value In Millions(£)', y='Age', data=df)
```

```
<AxesSubplot: xlabel='Markey Value In Millions(£)', ylabel='Age'>
```



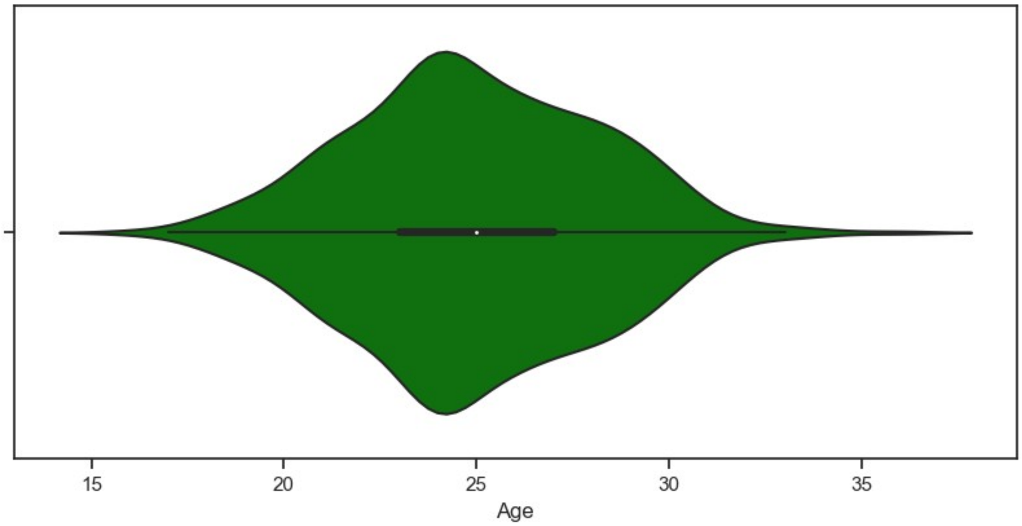
```
sns.violinplot(x=df['Age'])
```

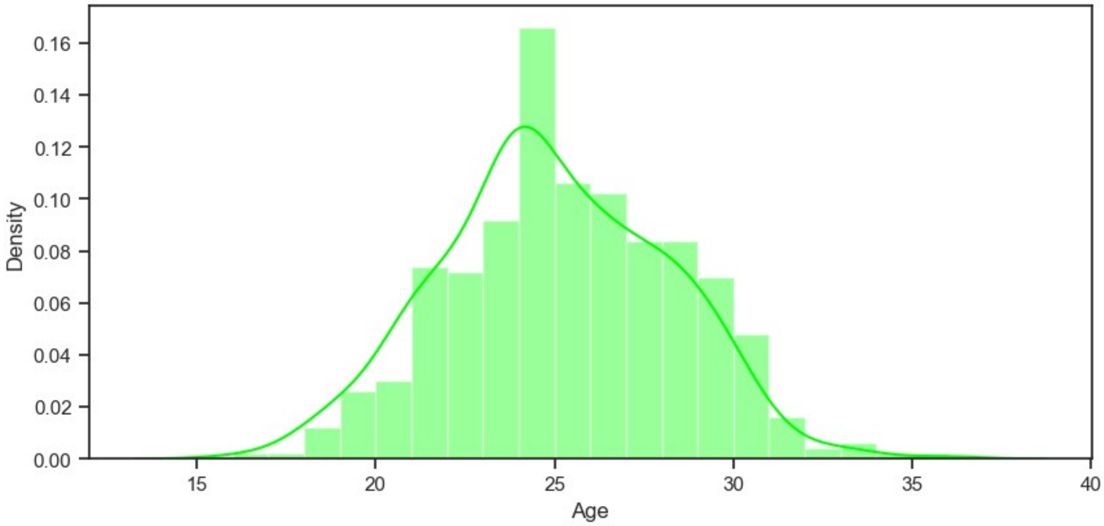
```
<AxesSubplot: xlabel='Age'>
```



```
fig, ax = plt.subplots(2, 1, figsize=(10,10))
sns.violinplot(ax=ax[0], x=df['Age'], color='green')
sns.distplot(df['Age'], ax=ax[1], color='lime')
```

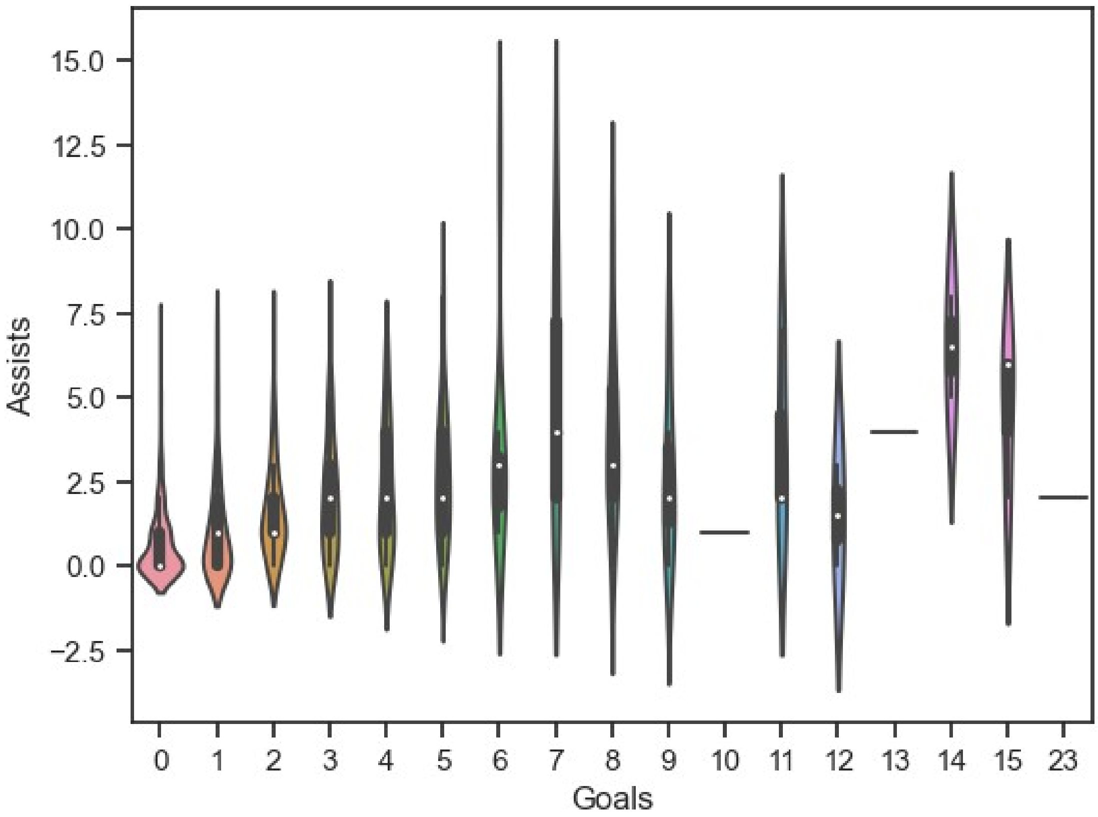
```
C:\Users\Артемий\AppData\Local\Temp\ipykernel_10120\2203891327.py:3:
UserWarning:

`distplot` is a deprecated function and will be removed in seaborn
v0.14.0.

Please adapt your code to use either `displot` (a figure-level
function with
similar flexibility) or `histplot` (an axes-level function for
histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df['Age'], ax=ax[1], color='lime')

<AxesSubplot: xlabel='Age', ylabel='Density'>
```





```
# Распределение параметра Humidity сгруппированные по Occupancy.
sns.violinplot(x='Goals', y='Assists', data=df)
```

```
<AxesSubplot: xlabel='Goals', ylabel='Assists'>
```



4) Информация о корреляции признаков

Проверка корреляции признаков позволяет решить две задачи:

1) Понять какие признаки (колонки датасета) наиболее сильно коррелируют с целевым признаком (в нашем примере это колонка "Occupancy"). Именно эти признаки будут наиболее информативными для моделей машинного обучения. Признаки, которые слабо коррелируют с целевым признаком, можно попробовать исключить из построения модели, иногда это повышает качество модели. Нужно отметить, что некоторые алгоритмы машинного обучения автоматически определяют ценность того или иного признака для построения модели. 2) Понять какие нецелевые признаки линейно зависимы между собой. Линейно зависимые признаки, как правило, очень плохо влияют на качество моделей. Поэтому если несколько признаков линейно зависимы, то для построения модели из них выбирают какой-то один признак.

```
df.corr()
```

```
C:\Users\Артемий\AppData\Local\Temp\ipykernel_10120\1134722465.py:1:
FutureWarning: The default value of numeric_only in DataFrame.corr is
deprecated. In a future version, it will default to False. Select only
valid columns or specify the value of numeric_only to silence this
```

```
warning.
  df.corr()

                             Unnamed: 0       Age  \
Unnamed: 0                     1.000000 -0.031027
Age                           -0.031027  1.000000
Markey Value In Millions(£)   -0.840651  0.047794
Matches                       -0.123702 -0.029396
Goals                         -0.172072  0.056607
Own Goals                      0.020754  0.038849
Assists                       -0.165223 -0.041616
Yellow Cards                  -0.036231 -0.059783
Second Yellow Cards           -0.063670 -0.055751
Red Cards                     -0.035685 -0.012872
Number Of Substitute In        0.055554 -0.135682
Number Of Substitute Out      -0.011886 -0.110354

                             Markey Value In Millions(£)   Matches
Goals  \
Unnamed: 0                                     -0.840651 -0.123702 -
0.172072
Age                                             0.047794 -0.029396
0.056607
Markey Value In Millions(£)                     1.000000  0.112774
0.213461
Matches                                         0.112774  1.000000
0.368270
Goals                                           0.213461  0.368270
1.000000
Own Goals                                      -0.032827  0.037999 -
0.091276
Assists                                         0.228183  0.407905
0.472086
Yellow Cards                                    0.003802  0.409519
0.024856
Second Yellow Cards                             0.041953 -0.000317 -
0.055523
Red Cards                                       0.001485  0.019569 -
0.022166
Number Of Substitute In                        -0.085958  0.224711
0.084144
Number Of Substitute Out                        0.000946  0.477138
0.437487

                             Own Goals   Assists  Yellow Cards  \
Unnamed: 0                    0.020754 -0.165223     -0.036231
Age                           0.038849 -0.041616     -0.059783
Markey Value In Millions(£)  -0.032827  0.228183      0.003802
Matches                       0.037999  0.407905      0.409519
Goals                        -0.091276  0.472086      0.024856
```

```
Own Goals                     1.000000 -0.092988      0.057804
Assists                      -0.092988  1.000000      0.133521
Yellow Cards                  0.057804  0.133521      1.000000
Second Yellow Cards          -0.033985 -0.041855      0.076899
Red Cards                    -0.038617  0.001155      0.088482
Number Of Substitute In      -0.041531  0.083829     -0.065864
Number Of Substitute Out     -0.096794  0.452794      0.133355

                             Second Yellow Cards  Red Cards  \
Unnamed: 0                             -0.063670  -0.035685
Age                                    -0.055751  -0.012872
Markey Value In Millions(£)             0.041953   0.001485
Matches                                -0.000317   0.019569
Goals                                  -0.055523  -0.022166
Own Goals                              -0.033985  -0.038617
Assists                                -0.041855   0.001155
Yellow Cards                            0.076899   0.088482
Second Yellow Cards                     1.000000   0.060064
Red Cards                               0.060064   1.000000
Number Of Substitute In                -0.077221  -0.030601
Number Of Substitute Out               -0.066548  -0.006129

                             Number Of Substitute In  Number Of
Substitute Out
Unnamed: 0                                  0.055554                 -
0.011886
Age                                        -0.135682                 -
0.110354
Markey Value In Millions(£)                -0.085958
0.000946
Matches                                     0.224711
0.477138
Goals                                       0.084144
0.437487
Own Goals                                  -0.041531                 -
0.096794
Assists                                     0.083829
0.452794
Yellow Cards                               -0.065864
0.133355
Second Yellow Cards                        -0.077221                 -
0.066548
Red Cards                                  -0.030601                 -
0.006129
Number Of Substitute In                     1.000000
0.247122
Number Of Substitute Out                    0.247122
1.000000
```

```
df.corr(method='pearson')
```

```
C:\Users\Артемий\AppData\Local\Temp\ipykernel_10120\1928163937.py:1:
FutureWarning: The default value of numeric_only in DataFrame.corr is
deprecated. In a future version, it will default to False. Select only
valid columns or specify the value of numeric_only to silence this
warning.
  df.corr(method='pearson')

                             Unnamed: 0       Age  \
Unnamed: 0                     1.000000 -0.031027
Age                           -0.031027  1.000000
Markey Value In Millions(£)   -0.840651  0.047794
Matches                       -0.123702 -0.029396
Goals                         -0.172072  0.056607
Own Goals                      0.020754  0.038849
Assists                       -0.165223 -0.041616
Yellow Cards                  -0.036231 -0.059783
Second Yellow Cards           -0.063670 -0.055751
Red Cards                     -0.035685 -0.012872
Number Of Substitute In        0.055554 -0.135682
Number Of Substitute Out      -0.011886 -0.110354

                             Markey Value In Millions(£)   Matches
Goals  \
Unnamed: 0                                     -0.840651 -0.123702 -
0.172072
Age                                             0.047794 -0.029396
0.056607
Markey Value In Millions(£)                     1.000000  0.112774
0.213461
Matches                                         0.112774  1.000000
0.368270
Goals                                           0.213461  0.368270
1.000000
Own Goals                                      -0.032827  0.037999 -
0.091276
Assists                                         0.228183  0.407905
0.472086
Yellow Cards                                    0.003802  0.409519
0.024856
Second Yellow Cards                             0.041953 -0.000317 -
0.055523
Red Cards                                       0.001485  0.019569 -
0.022166
Number Of Substitute In                        -0.085958  0.224711
0.084144
Number Of Substitute Out                        0.000946  0.477138
0.437487

                             Own Goals   Assists  Yellow Cards  \
Unnamed: 0                    0.020754 -0.165223     -0.036231
```

```
Age                            0.038849 -0.041616     -0.059783
Markey Value In Millions(£)   -0.032827  0.228183      0.003802
Matches                        0.037999  0.407905      0.409519
Goals                         -0.091276  0.472086      0.024856
Own Goals                      1.000000 -0.092988      0.057804
Assists                       -0.092988  1.000000      0.133521
Yellow Cards                   0.057804  0.133521      1.000000
Second Yellow Cards           -0.033985 -0.041855      0.076899
Red Cards                     -0.038617  0.001155      0.088482
Number Of Substitute In       -0.041531  0.083829     -0.065864
Number Of Substitute Out      -0.096794  0.452794      0.133355

                             Second Yellow Cards  Red Cards  \
Unnamed: 0                             -0.063670  -0.035685
Age                                    -0.055751  -0.012872
Markey Value In Millions(£)             0.041953   0.001485
Matches                                -0.000317   0.019569
Goals                                  -0.055523  -0.022166
Own Goals                              -0.033985  -0.038617
Assists                                -0.041855   0.001155
Yellow Cards                            0.076899   0.088482
Second Yellow Cards                     1.000000   0.060064
Red Cards                               0.060064   1.000000
Number Of Substitute In                -0.077221  -0.030601
Number Of Substitute Out               -0.066548  -0.006129

                             Number Of Substitute In  Number Of
Substitute Out
Unnamed: 0                                  0.055554                 -
0.011886
Age                                        -0.135682                 -
0.110354
Markey Value In Millions(£)                -0.085958
0.000946
Matches                                     0.224711
0.477138
Goals                                       0.084144
0.437487
Own Goals                                  -0.041531                 -
0.096794
Assists                                     0.083829
0.452794
Yellow Cards                               -0.065864
0.133355
Second Yellow Cards                        -0.077221                 -
0.066548
Red Cards                                  -0.030601                 -
0.006129
Number Of Substitute In                     1.000000
0.247122
```

```
Number Of Substitute Out                    0.247122
1.000000
```

```
df.corr(method='kendall')
```

```
C:\Users\Артемий\AppData\Local\Temp\ipykernel_10120\1723791258.py:1:
FutureWarning: The default value of numeric_only in DataFrame.corr is
deprecated. In a future version, it will default to False. Select only
valid columns or specify the value of numeric_only to silence this
warning.
  df.corr(method='kendall')

----------------------------------------------------------------------
-----
ModuleNotFoundError                       Traceback (most recent call
last)
Cell In[54], line 1
----> 1 df.corr(method='kendall')

File ~\AppData\Local\Programs\Python\Python311\Lib\site-packages\
pandas\core\frame.py:10314, in DataFrame.corr(self, method,
min_periods, numeric_only)
  10312     min_periods = 1
  10313 mat = mat.T
> 10314 corrf = nanops.get_corr_func(method)
  10315 K = len(cols)
  10316 correl = np.empty((K, K), dtype=float)

File ~\AppData\Local\Programs\Python\Python311\Lib\site-packages\
pandas\core\nanops.py:1559, in get_corr_func(method)
   1557 def get_corr_func(method) -> Callable[[np.ndarray,
np.ndarray], float]:
   1558     if method == "kendall":
-> 1559         from scipy.stats import kendalltau
   1561         def func(a, b):
   1562             return kendalltau(a, b)[0]

ModuleNotFoundError: No module named 'scipy'
```

```
df.corr(method='spearman')
```

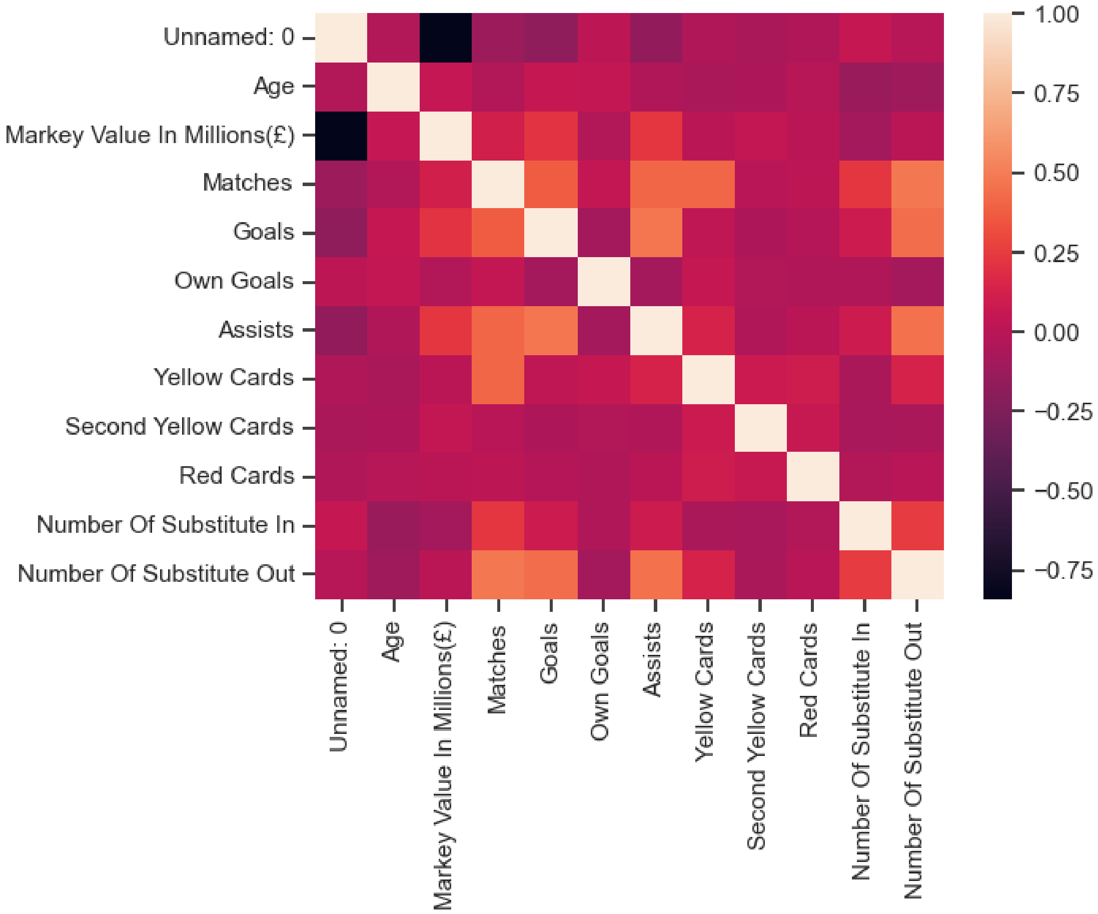
```
C:\Users\Артемий\AppData\Local\Temp\ipykernel_10120\1222267885.py:1:
FutureWarning: The default value of numeric_only in DataFrame.corr is
deprecated. In a future version, it will default to False. Select only
valid columns or specify the value of numeric_only to silence this
warning.
  df.corr(method='spearman')

                             Unnamed: 0       Age  \
Unnamed: 0                     1.000000 -0.028830
Age                           -0.028830  1.000000
```

```
Markey Value In Millions(£)   -0.996407  0.089105
Matches                       -0.120222 -0.052242
Goals                         -0.193555  0.035237
Own Goals                      0.020754  0.046780
Assists                       -0.150669 -0.032752
Yellow Cards                  -0.048696 -0.030374
Second Yellow Cards           -0.063670 -0.066797
Red Cards                     -0.035685 -0.003424
Number Of Substitute In        0.059360 -0.132148
Number Of Substitute Out      -0.039501 -0.104027

                             Markey Value In Millions(£)   Matches
Goals  \
Unnamed: 0                                     -0.996407 -0.120222 -
0.193555
Age                                             0.089105 -0.052242
0.035237
Markey Value In Millions(£)                     1.000000  0.109343
0.191587
Matches                                         0.109343  1.000000
0.371900
Goals                                           0.191587  0.371900
1.000000
Own Goals                                      -0.016060  0.034348 -
0.107108
Assists                                         0.147096  0.421626
0.502999
Yellow Cards                                    0.039076  0.386002
0.049976
Second Yellow Cards                             0.057107 -0.021453 -
0.038466
Red Cards                                       0.032229  0.014499 -
0.035603
Number Of Substitute In                        -0.065191  0.177082
0.219114
Number Of Substitute Out                        0.031596  0.439418
0.481925

                             Own Goals   Assists  Yellow Cards  \
Unnamed: 0                    0.020754 -0.150669     -0.048696
Age                           0.046780 -0.032752     -0.030374
Markey Value In Millions(£)  -0.016060  0.147096      0.039076
Matches                       0.034348  0.421626      0.386002
Goals                        -0.107108  0.502999      0.049976
Own Goals                     1.000000 -0.115023      0.050303
Assists                      -0.115023  1.000000      0.141150
Yellow Cards                  0.050303  0.141150      1.000000
Second Yellow Cards          -0.033985 -0.032572      0.099313
Red Cards                    -0.038617  0.002852      0.077371
Number Of Substitute In      -0.062330  0.182926     -0.085237
Number Of Substitute Out     -0.101096  0.509122      0.111688

                             Second Yellow Cards  Red Cards  \
Unnamed: 0                             -0.063670  -0.035685   
Age                                    -0.066797  -0.003424   
Markey Value In Millions(£)             0.057107   0.032229   
Matches                                -0.021453   0.014499   
Goals                                  -0.038466  -0.035603   
Own Goals                              -0.033985  -0.038617   
Assists                                -0.032572   0.002852   
Yellow Cards                            0.099313   0.077371   
Second Yellow Cards                     1.000000   0.060064   
Red Cards                               0.060064   1.000000   
Number Of Substitute In                -0.071373  -0.030205   
Number Of Substitute Out               -0.061417  -0.002331   

                             Number Of Substitute In  Number Of 
Substitute Out  
Unnamed: 0                                  0.059360                 -
0.039501  
Age                                        -0.132148                 -
0.104027  
Markey Value In Millions(£)                -0.065191                  
0.031596  
Matches                                     0.177082                  
0.439418  
Goals                                       0.219114                  
0.481925  
Own Goals                                  -0.062330                 -
0.101096  
Assists                                     0.182926                  
0.509122  
Yellow Cards                               -0.085237                  
0.111688  
Second Yellow Cards                        -0.071373                 -
0.061417  
Red Cards                                  -0.030205                 -
0.002331  
Number Of Substitute In                     1.000000                  
0.384864  
Number Of Substitute Out                    0.384864                  
1.000000  
```

```
sns.heatmap(df.corr())
```

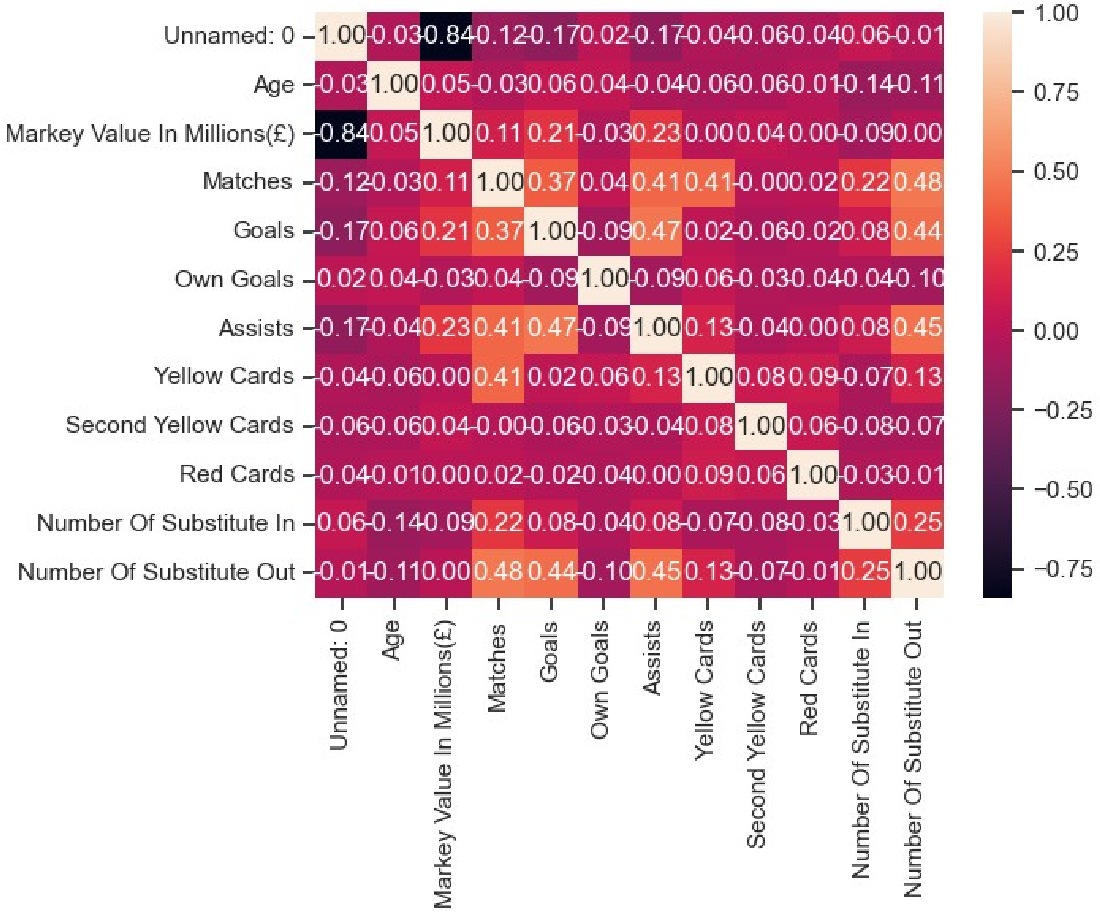
```
C:\Users\Артемий\AppData\Local\Temp\ipykernel_10120\58359773.py:1: 
FutureWarning: The default value of numeric_only in DataFrame.corr is 
deprecated. In a future version, it will default to False. Select only 
valid columns or specify the value of numeric_only to silence this 
```

```
warning.
  sns.heatmap(df.corr())

<AxesSubplot: >
```



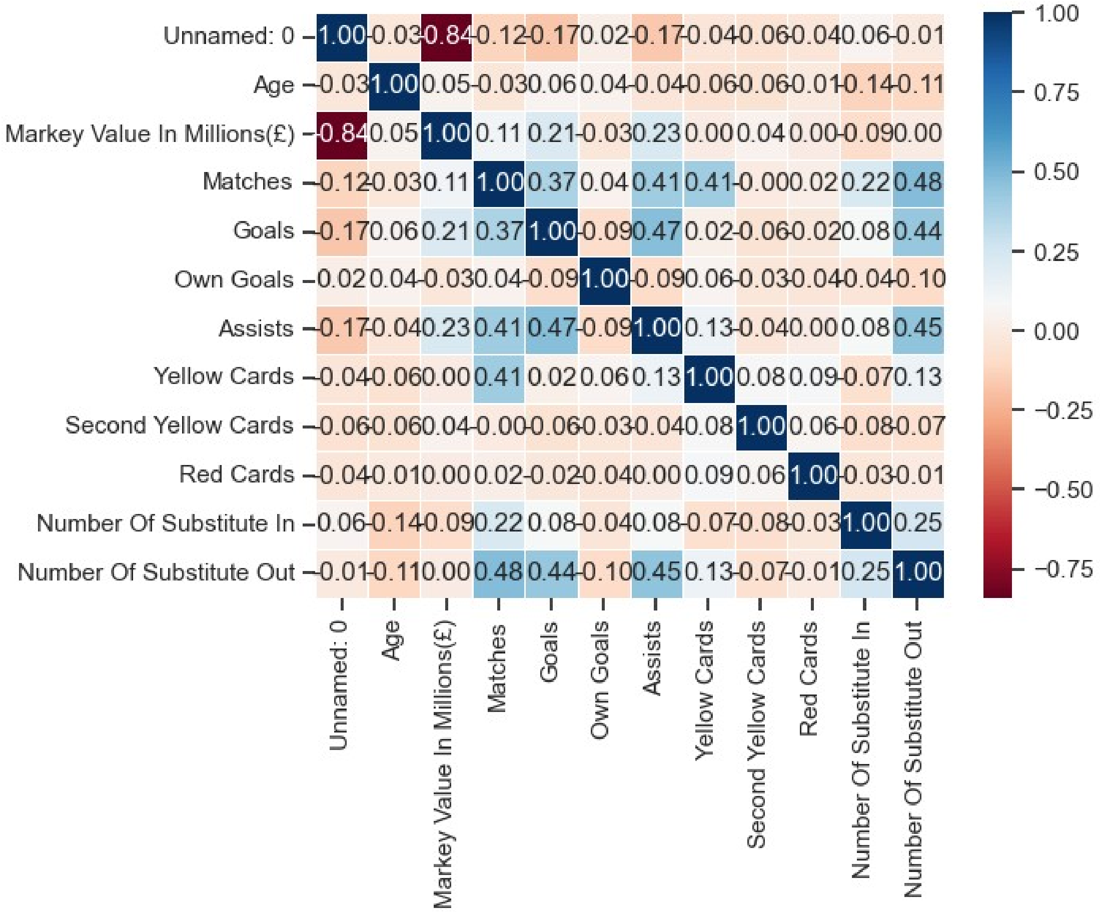
```python
# Вывод значений в ячейках
sns.heatmap(df.corr(), annot=True, fmt='.2f')
```

```
C:\Users\Артемий\AppData\Local\Temp\ipykernel_10120\958188786.py:2:
FutureWarning: The default value of numeric_only in DataFrame.corr is
deprecated. In a future version, it will default to False. Select only
valid columns or specify the value of numeric_only to silence this
warning.
  sns.heatmap(df.corr(), annot=True, fmt='.2f')

<AxesSubplot: >
```



```
# Изменение цветовой гаммы
sns.heatmap(df.corr(), cmap='RdBu', annot=True, fmt='.2f',
linewidths=.5)
```

```
C:\Users\Артемий\AppData\Local\Temp\ipykernel_10120\3697374902.py:2:
FutureWarning: The default value of numeric_only in DataFrame.corr is
deprecated. In a future version, it will default to False. Select only
valid columns or specify the value of numeric_only to silence this
warning.
  sns.heatmap(df.corr(), cmap='RdBu', annot=True, fmt='.2f',
linewidths=.5)

<AxesSubplot: >
```

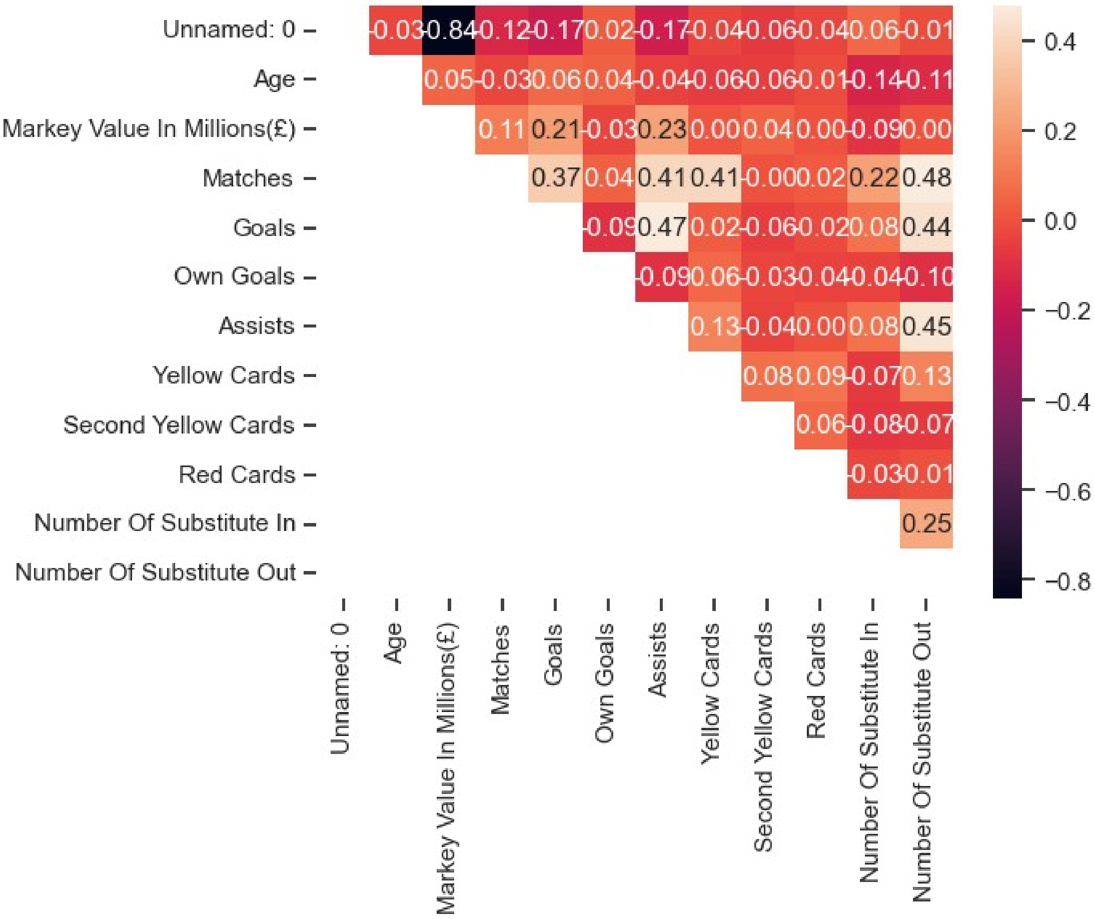


```
# Треугольный вариант матрицы
mask = np.zeros_like(df.corr(), dtype=np.bool)
# чтобы оставить нижнюю часть матрицы
# mask[np.triu_indices_from(mask)] = True
# чтобы оставить верхнюю часть матрицы
mask[np.tril_indices_from(mask)] = True
sns.heatmap(df.corr(), mask=mask, annot=True, fmt='.2f')
```

```
C:\Users\Артемий\AppData\Local\Temp\ipykernel_10120\4151092195.py:2:
FutureWarning: The default value of numeric_only in DataFrame.corr is
deprecated. In a future version, it will default to False. Select only
valid columns or specify the value of numeric_only to silence this
warning.
  mask = np.zeros_like(df.corr(), dtype=np.bool)
C:\Users\Артемий\AppData\Local\Temp\ipykernel_10120\4151092195.py:2:
DeprecationWarning: `np.bool` is a deprecated alias for the builtin
`bool`. To silence this warning, use `bool` by itself. Doing this will
not modify any behavior and is safe. If you specifically wanted the
numpy scalar type, use `np.bool_` here.
Deprecated in NumPy 1.20; for more details and guidance:
https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations
  mask = np.zeros_like(df.corr(), dtype=np.bool)
```

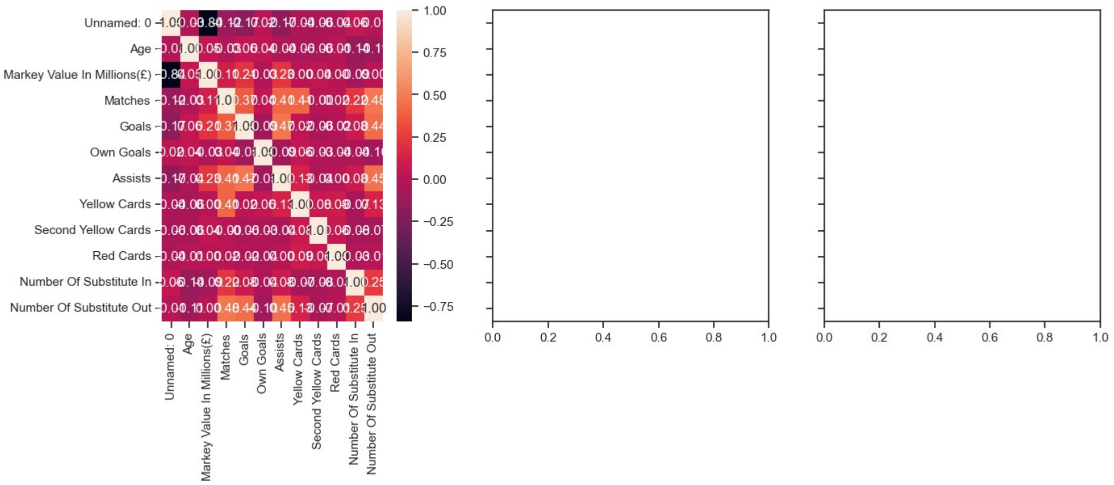
```
C:\Users\Артемий\AppData\Local\Temp\ipykernel_10120\4151092195.py:7:
FutureWarning: The default value of numeric_only in DataFrame.corr is
deprecated. In a future version, it will default to False. Select only
valid columns or specify the value of numeric_only to silence this
warning.
  sns.heatmap(df.corr(), mask=mask, annot=True, fmt='.2f')
```

```
<AxesSubplot: >
```



```
fig, ax = plt.subplots(1, 3, sharex='col', sharey='row',
figsize=(15,5))
sns.heatmap(df.corr(method='pearson'), ax=ax[0], annot=True,
fmt='.2f')
sns.heatmap(df.corr(method='kendall'), ax=ax[1], annot=True,
fmt='.2f')
sns.heatmap(df.corr(method='spearman'), ax=ax[2], annot=True,
fmt='.2f')
fig.suptitle('Корреляционные матрицы, построенные различными
методами')
ax[0].title.set_text('Pearson')
ax[1].title.set_text('Kendall')
ax[2].title.set_text('Spearman')
```

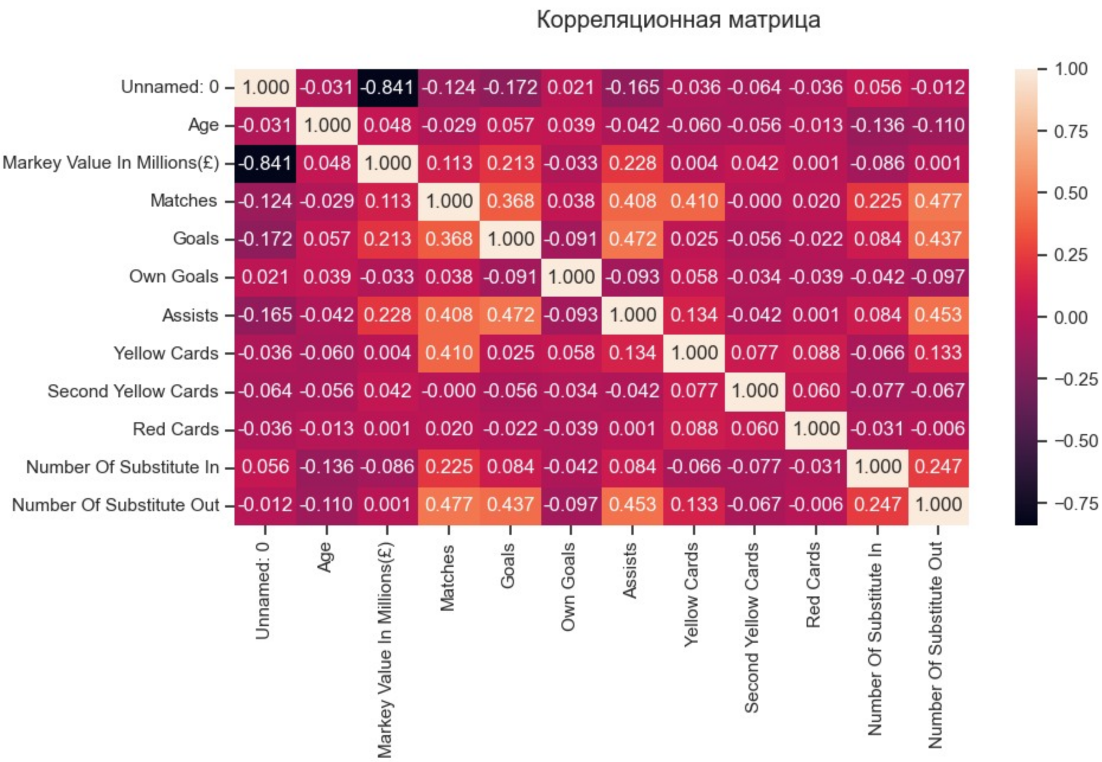
```
C:\Users\Артемий\AppData\Local\Temp\ipykernel_10120\2444923100.py:2:
FutureWarning: The default value of numeric_only in DataFrame.corr is
deprecated. In a future version, it will default to False. Select only
valid columns or specify the value of numeric_only to silence this
warning.
  sns.heatmap(df.corr(method='pearson'), ax=ax[0], annot=True,
fmt='.2f')
C:\Users\Артемий\AppData\Local\Temp\ipykernel_10120\2444923100.py:3:
FutureWarning: The default value of numeric_only in DataFrame.corr is
deprecated. In a future version, it will default to False. Select only
valid columns or specify the value of numeric_only to silence this
warning.
  sns.heatmap(df.corr(method='kendall'), ax=ax[1], annot=True,
fmt='.2f')

----------------------------------------------------------------------
-----
ModuleNotFoundError                       Traceback (most recent call
last)
Cell In[66], line 3
      1 fig, ax = plt.subplots(1, 3, sharex='col', sharey='row',
figsize=(15,5))
      2 sns.heatmap(df.corr(method='pearson'), ax=ax[0], annot=True,
fmt='.2f')
----> 3 sns.heatmap(df.corr(method='kendall'), ax=ax[1], annot=True,
fmt='.2f')
      4 sns.heatmap(df.corr(method='spearman'), ax=ax[2], annot=True,
fmt='.2f')
      5 fig.suptitle('Корреляционные матрицы, построенные различными
методами')

File ~\AppData\Local\Programs\Python\Python311\Lib\site-packages\
pandas\core\frame.py:10314, in DataFrame.corr(self, method,
min_periods, numeric_only)
  10312     min_periods = 1
  10313 mat = mat.T
> 10314 corrf = nanops.get_corr_func(method)
  10315 K = len(cols)
  10316 correl = np.empty((K, K), dtype=float)

File ~\AppData\Local\Programs\Python\Python311\Lib\site-packages\
pandas\core\nanops.py:1559, in get_corr_func(method)
   1557 def get_corr_func(method) -> Callable[[np.ndarray,
np.ndarray], float]:
   1558     if method == "kendall":
-> 1559         from scipy.stats import kendalltau
   1561         def func(a, b):
   1562             return kendalltau(a, b)[0]

ModuleNotFoundError: No module named 'scipy'
```



```
fig, ax = plt.subplots(1, 1, sharex='col', sharey='row',
figsize=(10,5))
fig.suptitle('Корреляционная матрица')
sns.heatmap(df.corr(), ax=ax, annot=True, fmt='.3f')
```

```
C:\Users\Артемий\AppData\Local\Temp\ipykernel_10120\2908733683.py:3:
FutureWarning: The default value of numeric_only in DataFrame.corr is
deprecated. In a future version, it will default to False. Select only
valid columns or specify the value of numeric_only to silence this
warning.
  sns.heatmap(df.corr(), ax=ax, annot=True, fmt='.3f')
```

```
<AxesSubplot: >
```



Корреляционная матрица