shell-datathon-2

July 19, 2023

[317]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.linear_model import LinearRegression
from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import RandomForestRegressor
from sklearn.svm import SVR
from sklearn.ensemble import GradientBoostingRegressor
from sklearn.neighbors import KNeighborsRegressor
from sklearn.model_selection import train_test_split
from statsmodels.tsa.arima.model import ARIMA
from sklearn.preprocessing import MinMaxScaler
from sklearn.metrics import mean_squared_error, r2_score, mean_absolute_error
```

[318]:
```
otv = pd.read_csv("otv.csv")
```

[319]:
```
otv.head()
```

[319]:

	Tarih	ÖTV	Adet	ÖTV Oranı	ÖTV uygulanan Ürün Adı
0	2018-05-22	2124.10	1000	2.12410	Kursunsuz Benzin 95
1	2018-05-22	2124.10	1000	2.12410	Kursunsuz Benzin 95
2	2018-05-22	2081.62	1000	2.08162	Etanollü Kurşunsuz Benzin 95
3	2018-05-22	2081.62	1000	2.08162	Etanollü Kurşunsuz Benzin 95
4	2018-05-22	1567.90	1000	1.56790	Motorin

[320]:
```
otv.columns
```

[320]:
```
Index(['Tarih', 'ÖTV ', 'Adet', 'ÖTV Oranı', 'ÖTV uygulanan Ürün Adı'],
dtype='object')
```

[321]:
```
otv = otv.rename(columns={
    "Tarih":"Date",
    "ÖTV Oranı":"ÖTV_Oranı",
    "ÖTV uygulanan Ürün Adı":"ÖTV_Uygulanan_Ürün_Adı"
})
```

[322]:
```
otv["Date"] = pd.to_datetime(otv["Date"])
```

[323]:
```
otv.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 417 entries, 0 to 416
Data columns (total 5 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   Date                    417 non-null    datetime64[ns]
 1   ÖTV                     417 non-null    float64
 2   Adet                    417 non-null    int64
 3   ÖTV_Oranı               417 non-null    float64
 4   ÖTV_Uygulanan_Ürün_Adı  417 non-null    object
dtypes: datetime64[ns](1), float64(2), int64(1), object(1)
memory usage: 16.4+ KB
```

[324]:
```
unique_dates = otv["Date"].drop_duplicates()
all_dates = pd.date_range(start=unique_dates.min(), end=unique_dates.max())
all_dates
```

[324]:
```
DatetimeIndex(['2018-05-22', '2018-05-23', '2018-05-24', '2018-05-25',
               '2018-05-26', '2018-05-27', '2018-05-28', '2018-05-29',
               '2018-05-30', '2018-05-31',
               …
               '2022-02-20', '2022-02-21', '2022-02-22', '2022-02-23',
               '2022-02-24', '2022-02-25', '2022-02-26', '2022-02-27',
               '2022-02-28', '2022-03-01'],
              dtype='datetime64[ns]', length=1380, freq='D')
```

[325]:
```
missing_dates = all_dates[~all_dates.isin(otv["Date"])]
missing_dates_df = pd.DataFrame({'Date': missing_dates})
otv = pd.concat([otv, missing_dates_df], ignore_index=True)
otv.sort_values(by="Date", inplace=True)
otv.fillna(np.nan, inplace=True)
otv.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1667 entries, 0 to 415
Data columns (total 5 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   Date                    1667 non-null   datetime64[ns]
 1   ÖTV                     417 non-null    float64
 2   Adet                    417 non-null    float64
 3   ÖTV_Oranı               417 non-null    float64
 4   ÖTV_Uygulanan_Ürün_Adı  417 non-null    object
dtypes: datetime64[ns](1), float64(3), object(1)
```

```
memory usage: 78.1+ KB
```

[326]:
```
platts = pd.read_csv("platts.csv")
```

[327]:
```
platts.head()
```

[327]:
```
         Tarih                                  Ürün Avrupa Birliği Birimi  \
0  2022-12-31  10 ppm ULSD CIF Med (Genova/Lavera)                   $/TON
1  2022-12-30  10 ppm ULSD CIF Med (Genova/Lavera)                   $/TON
2  2022-12-29  10 ppm ULSD CIF Med (Genova/Lavera)                   $/TON
3  2022-12-28  10 ppm ULSD CIF Med (Genova/Lavera)                   $/TON
4  2022-12-27  10 ppm ULSD CIF Med (Genova/Lavera)                   $/TON

   AB Piyasa Fiyatı  AB Piyasa Fiyatı- Yüksek  AB Piyasa Fiyatı- Düşük  \
0            932.25                    932.50                   932.00
1            932.25                    932.50                   932.00
2            927.00                    927.25                   926.75
3            926.25                    926.50                   926.00
4            920.00                    920.25                   919.75

   Dolar Kuru (Satış)
0             18.7320
1             18.7320
2             18.7303
3             18.7301
4             18.7150
```

[328]:
```
platts.columns
```

[328]:
```
Index(['Tarih', 'Ürün', 'Avrupa Birliği Birimi', 'AB Piyasa Fiyatı',
       'AB Piyasa Fiyatı- Yüksek', 'AB Piyasa Fiyatı- Düşük',
       'Dolar Kuru (Satış)'],
      dtype='object')
```

[329]:
```
platts = platts.rename(columns={
    "Tarih":"Date",
    "Avrupa Birliği Birimi":"Avrupa_Birliği_Birimi(Platts)",
    "AB Piyasa Fiyatı":"AB_Piyasa_Fiyatı(Platts)",
    "AB Piyasa Fiyatı- Yüksek":"AB_Piyasa_Fiyatı_Yüksek(Platts)",
    "AB Piyasa Fiyatı- Düşük":"AB_Piyasa_Fiyatı_Düşük(Platts)",
    "Dolar Kuru (Satış)":"Dolar_Kuru(Satış)(Platts)"
})
```

[330]:
```
platts["Date"] = pd.to_datetime(platts["Date"])
```

[331]:
```
platts.info()
```

```
<class 'pandas.core.frame.DataFrame'>
```

```
RangeIndex: 3650 entries, 0 to 3649
Data columns (total 7 columns):
 #   Column                            Non-Null Count  Dtype
---  ------                            --------------  -----
 0   Date                              3650 non-null   datetime64[ns]
 1   Ürün                              3650 non-null   object
 2   Avrupa_Birliği_Birimi(Platts)     3650 non-null   object
 3   AB_Piyasa_Fiyatı(Platts)          3650 non-null   float64
 4   AB_Piyasa_Fiyatı_Yüksek(Platts)   3650 non-null   float64
 5   AB_Piyasa_Fiyatı_Düşük(Platts)    3650 non-null   float64
 6   Dolar_Kuru(Satış)(Platts)         3650 non-null   float64
dtypes: datetime64[ns](1), float64(4), object(2)
memory usage: 199.7+ KB
```

[332]:
```
unique_dates = platts["Date"].drop_duplicates()
all_dates = pd.date_range(start=unique_dates.min(), end=unique_dates.max())
all_dates
```

[332]:
```
DatetimeIndex(['2018-01-02', '2018-01-03', '2018-01-04', '2018-01-05',
               '2018-01-06', '2018-01-07', '2018-01-08', '2018-01-09',
               '2018-01-10', '2018-01-11',
               …
               '2022-12-22', '2022-12-23', '2022-12-24', '2022-12-25',
               '2022-12-26', '2022-12-27', '2022-12-28', '2022-12-29',
               '2022-12-30', '2022-12-31'],
              dtype='datetime64[ns]', length=1825, freq='D')
```

[333]:
```
missing_dates = all_dates[~all_dates.isin(platts["Date"])]
missing_dates_df = pd.DataFrame({'Date': missing_dates})
platts = pd.concat([platts, missing_dates_df], ignore_index=True)
platts.sort_values(by="Date", inplace=True)
platts.fillna(np.nan, inplace=True)
platts.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 3650 entries, 1824 to 0
Data columns (total 7 columns):
 #   Column                            Non-Null Count  Dtype
---  ------                            --------------  -----
 0   Date                              3650 non-null   datetime64[ns]
 1   Ürün                              3650 non-null   object
 2   Avrupa_Birliği_Birimi(Platts)     3650 non-null   object
 3   AB_Piyasa_Fiyatı(Platts)          3650 non-null   float64
 4   AB_Piyasa_Fiyatı_Yüksek(Platts)   3650 non-null   float64
 5   AB_Piyasa_Fiyatı_Düşük(Platts)    3650 non-null   float64
 6   Dolar_Kuru(Satış)(Platts)         3650 non-null   float64
dtypes: datetime64[ns](1), float64(4), object(2)
memory usage: 228.1+ KB
```

[334]:
```
selected_rows = platts.loc[platts['Ürün'] == 'Prem Unl 10 ppm CIF Med (Genova/
↪Lavera)']
new_dataset = selected_rows.copy()
platts = platts.drop(platts[platts['Ürün'] == 'Prem Unl 10 ppm CIF Med (Genova/
↪Lavera)'].index)
```

[335]:
```
new_dataset.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1825 entries, 3649 to 1825
Data columns (total 7 columns):
 #   Column                           Non-Null Count  Dtype
---  ------                           --------------  -----
 0   Date                             1825 non-null   datetime64[ns]
 1   Ürün                             1825 non-null   object
 2   Avrupa_Birliği_Birimi(Platts)    1825 non-null   object
 3   AB_Piyasa_Fiyatı(Platts)         1825 non-null   float64
 4   AB_Piyasa_Fiyatı_Yüksek(Platts)  1825 non-null   float64
 5   AB_Piyasa_Fiyatı_Düşük(Platts)   1825 non-null   float64
 6   Dolar_Kuru(Satış)(Platts)        1825 non-null   float64
dtypes: datetime64[ns](1), float64(4), object(2)
memory usage: 114.1+ KB
```

[336]:
```
new_dataset.head()
```

[336]:

	Date	Ürün	\
3649	2018-01-02	Prem Unl 10 ppm CIF Med (Genova/Lavera)	
3648	2018-01-03	Prem Unl 10 ppm CIF Med (Genova/Lavera)	
3647	2018-01-04	Prem Unl 10 ppm CIF Med (Genova/Lavera)	
3646	2018-01-05	Prem Unl 10 ppm CIF Med (Genova/Lavera)	
3645	2018-01-06	Prem Unl 10 ppm CIF Med (Genova/Lavera)	

	Avrupa_Birliği_Birimi(Platts)	AB_Piyasa_Fiyatı(Platts)	\
3649	$/TON	632.75	
3648	$/TON	637.25	
3647	$/TON	633.25	
3646	$/TON	628.50	
3645	$/TON	628.50	

	AB_Piyasa_Fiyatı_Yüksek(Platts)	AB_Piyasa_Fiyatı_Düşük(Platts)	\
3649	633.00	632.50	
3648	637.50	637.00	
3647	633.50	633.00	
3646	628.75	628.25	
3645	628.75	628.25	

	Dolar_Kuru(Satış)(Platts)

```
3649                    3.7719
3648                    3.7685
3647                    3.7668
3646                    3.7523
3645                    3.7523
```

[337]:
```
platts.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1825 entries, 1824 to 0
Data columns (total 7 columns):
 #   Column                           Non-Null Count  Dtype
---  ------                           --------------  -----
 0   Date                             1825 non-null   datetime64[ns]
 1   Ürün                             1825 non-null   object
 2   Avrupa_Birliği_Birimi(Platts)    1825 non-null   object
 3   AB_Piyasa_Fiyatı(Platts)         1825 non-null   float64
 4   AB_Piyasa_Fiyatı_Yüksek(Platts)  1825 non-null   float64
 5   AB_Piyasa_Fiyatı_Düşük(Platts)   1825 non-null   float64
 6   Dolar_Kuru(Satış)(Platts)        1825 non-null   float64
dtypes: datetime64[ns](1), float64(4), object(2)
memory usage: 114.1+ KB
```

[338]:
```
platts.head()
```

[338]:
```
           Date                                Ürün  \
1824 2018-01-02  10 ppm ULSD CIF Med (Genova/Lavera)
1823 2018-01-03  10 ppm ULSD CIF Med (Genova/Lavera)
1822 2018-01-04  10 ppm ULSD CIF Med (Genova/Lavera)
1821 2018-01-05  10 ppm ULSD CIF Med (Genova/Lavera)
1820 2018-01-06  10 ppm ULSD CIF Med (Genova/Lavera)

     Avrupa_Birliği_Birimi(Platts)  AB_Piyasa_Fiyatı(Platts)  \
1824                         $/TON                     599.0
1823                         $/TON                     609.0
1822                         $/TON                     610.0
1821                         $/TON                     606.5
1820                         $/TON                     606.5

      AB_Piyasa_Fiyatı_Yüksek(Platts)  AB_Piyasa_Fiyatı_Düşük(Platts)  \
1824                           599.25                           598.75
1823                           609.25                           608.75
1822                           610.25                           609.75
1821                           606.75                           606.25
1820                           606.75                           606.25

      Dolar_Kuru(Satış)(Platts)
```

```
1824                    3.7719
1823                    3.7685
1822                    3.7668
1821                    3.7523
1820                    3.7523
```

[339]:
```
platts = platts.rename(columns={
    "AB_Piyasa_Fiyatı(Platts)":"AB_Piyasa_Fiyatı(Platts)_10_ppm_ULSD",
    "AB_Piyasa_Fiyatı_Yüksek(Platts)":
 ↪"AB_Piyasa_Fiyatı_Yüksek(Platts)_10_ppm_ULSD",
    "AB_Piyasa_Fiyatı_Düşük(Platts)":
 ↪"AB_Piyasa_Fiyatı_Düşük(Platts)_10_ppm_ULSD",
    "Dolar_Kuru(Satış)(Platts)":"Dolar_Kuru(Satış)(Platts)_10_ppm_ULSD"
})
platts = platts.drop(columns=["Ürün"])
platts.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1825 entries, 1824 to 0
Data columns (total 6 columns):
 #   Column                                    Non-Null Count  Dtype
---  ------                                    --------------  -----
 0   Date                                      1825 non-null   datetime64[ns]
 1   Avrupa_Birliği_Birimi(Platts)             1825 non-null   object
 2   AB_Piyasa_Fiyatı(Platts)_10_ppm_ULSD      1825 non-null   float64
 3   AB_Piyasa_Fiyatı_Yüksek(Platts)_10_ppm_ULSD  1825 non-null   float64
 4   AB_Piyasa_Fiyatı_Düşük(Platts)_10_ppm_ULSD   1825 non-null   float64
 5   Dolar_Kuru(Satış)(Platts)_10_ppm_ULSD     1825 non-null   float64
dtypes: datetime64[ns](1), float64(4), object(1)
memory usage: 99.8+ KB
```

[340]:
```
new_dataset = new_dataset.rename(columns={
    "AB_Piyasa_Fiyatı(Platts)":"AB_Piyasa_Fiyatı(Platts)_Prem_Unl_10_ppm",
    "AB_Piyasa_Fiyatı_Yüksek(Platts)":
 ↪"AB_Piyasa_Fiyatı_Yüksek(Platts)_Prem_Unl_10_ppm",
    "AB_Piyasa_Fiyatı_Düşük(Platts)":
 ↪"AB_Piyasa_Fiyatı_Düşük(Platts)_Prem_Unl_10_ppm",
    "Dolar_Kuru(Satış)(Platts)":"Dolar_Kuru(Satış)(Platts)_Prem_Unl_10_ppm"
})
new_dataset = new_dataset.drop(columns=["Ürün","Avrupa_Birliği_Birimi(Platts)"])
new_dataset.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1825 entries, 3649 to 1825
Data columns (total 5 columns):
 #   Column                                    Non-Null Count  Dtype
---  ------                                    --------------  -----
```

```
 0   Date                                          1825 non-null
datetime64[ns]
 1   AB_Piyasa_Fiyatı(Platts)_Prem_Unl_10_ppm      1825 non-null   float64
 2   AB_Piyasa_Fiyatı_Yüksek(Platts)_Prem_Unl_10_ppm  1825 non-null   float64
 3   AB_Piyasa_Fiyatı_Düşük(Platts)_Prem_Unl_10_ppm   1825 non-null   float64
 4   Dolar_Kuru(Satış)(Platts)_Prem_Unl_10_ppm     1825 non-null   float64
dtypes: datetime64[ns](1), float64(4)
memory usage: 85.5 KB
```

[341]:
```
platts = pd.merge(platts, new_dataset, on="Date", how="outer")
platts.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1825 entries, 0 to 1824
Data columns (total 10 columns):
 #   Column                                        Non-Null Count  Dtype
---  ------                                        --------------  -----
 0   Date                                          1825 non-null
datetime64[ns]
 1   Avrupa_Birliği_Birimi(Platts)                 1825 non-null   object
 2   AB_Piyasa_Fiyatı(Platts)_10_ppm_ULSD          1825 non-null   float64
 3   AB_Piyasa_Fiyatı_Yüksek(Platts)_10_ppm_ULSD   1825 non-null   float64
 4   AB_Piyasa_Fiyatı_Düşük(Platts)_10_ppm_ULSD    1825 non-null   float64
 5   Dolar_Kuru(Satış)(Platts)_10_ppm_ULSD         1825 non-null   float64
 6   AB_Piyasa_Fiyatı(Platts)_Prem_Unl_10_ppm      1825 non-null   float64
 7   AB_Piyasa_Fiyatı_Yüksek(Platts)_Prem_Unl_10_ppm  1825 non-null   float64
 8   AB_Piyasa_Fiyatı_Düşük(Platts)_Prem_Unl_10_ppm   1825 non-null   float64
 9   Dolar_Kuru(Satış)(Platts)_Prem_Unl_10_ppm     1825 non-null   float64
dtypes: datetime64[ns](1), float64(8), object(1)
memory usage: 142.7+ KB
```

[342]:
```
platts.head()
```

[342]:

	Date	Avrupa_Birliği_Birimi(Platts)	AB_Piyasa_Fiyatı(Platts)_10_ppm_ULSD
0	2018-01-02	$/TON	599.0
1	2018-01-03	$/TON	609.0
2	2018-01-04	$/TON	610.0
3	2018-01-05	$/TON	606.5
4	2018-01-06	$/TON	606.5

	AB_Piyasa_Fiyatı_Yüksek(Platts)_10_ppm_ULSD	AB_Piyasa_Fiyatı_Düşük(Platts)_10_ppm_ULSD	Dolar_Kuru(Satış)(Platts)_10_ppm_ULSD	AB_Piyasa_Fiyatı(Platts)_Prem_Unl_10_ppm	AB_Piyasa_Fiyatı_Yüksek(Platts)_Prem_Unl_10_ppm	AB_Piyasa_Fiyatı_Düşük(Platts)_Prem_Unl_10_ppm	Dolar_Kuru(Satış)(Platts)_Prem_Unl_10_ppm
0	599.25	598.75	3.7719	632.75	633.00	632.50	3.7719
1	609.25	608.75	3.7685	637.25	637.50	637.00	3.7685
2	610.25	609.75	3.7668	633.25	633.50	633.00	3.7668
3	606.75	606.25	3.7523	628.50	628.75	628.25	3.7523
4	606.75	606.25	3.7523	628.50	628.75	628.25	

```
4                                    3.7523
```

[343]:
```
usd = pd.read_csv("usd.csv")
```

[344]:
```
usd.head()
```

[344]:

	Yıl	Tarih	USD ALIŞ	USD SATIŞ	EUR ALIŞ	EUR SATIŞ	GBP ALIŞ	GBP SATIŞ
0	2018	2018-01-02	3.7719	3.7787	4.5155	4.5237	5.0803	5.1068
1	2018	2018-01-03	3.7652	3.7719	4.5375	4.5457	5.0910	5.1175
2	2018	2018-01-04	3.7617	3.7685	4.5267	4.5349	5.1014	5.1280
3	2018	2018-01-05	3.7600	3.7668	4.5269	4.5351	5.0818	5.1083
4	2018	2018-01-06	NaN	NaN	NaN	NaN	NaN	NaN

[345]:
```
usd.columns
```

[345]:
```
Index(['Yıl', 'Tarih', 'USD ALIŞ', 'USD SATIŞ', 'EUR ALIŞ', 'EUR SATIŞ',
       'GBP ALIŞ', 'GBP SATIŞ'],
      dtype='object')
```

[346]:
```
usd = usd.rename(columns={
    "Tarih":"Date",
    "USD ALIŞ":"USD_ALIŞ",
    "USD SATIŞ":"USD_SATIŞ",
    "EUR ALIŞ":"EUR_ALIŞ",
    "EUR SATIŞ":"EUR_SATIŞ",
    "GBP ALIŞ":"GBP_ALIŞ",
    "GBP SATIŞ":"GBP_SATIŞ",
})
```

[347]:
```
usd["Date"] = pd.to_datetime(usd["Date"])
```

[348]:
```
usd.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1857 entries, 0 to 1856
Data columns (total 8 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   Yıl        1857 non-null   int64
 1   Date       1857 non-null   datetime64[ns]
```

```
 2   USD_ALIŞ    1276 non-null   float64
 3   USD_SATIŞ   1276 non-null   float64
 4   EUR_ALIŞ    1276 non-null   float64
 5   EUR_SATIŞ   1276 non-null   float64
 6   GBP_ALIŞ    1276 non-null   float64
 7   GBP_SATIŞ   1276 non-null   float64
dtypes: datetime64[ns](1), float64(6), int64(1)
memory usage: 116.2 KB
```

[349]:
```
unique_dates = usd["Date"].drop_duplicates()
all_dates = pd.date_range(start=unique_dates.min(), end=unique_dates.max())
all_dates
```

[349]:
```
DatetimeIndex(['2018-01-02', '2018-01-03', '2018-01-04', '2018-01-05',
               '2018-01-06', '2018-01-07', '2018-01-08', '2018-01-09',
               '2018-01-10', '2018-01-11',
               …
               '2023-01-23', '2023-01-24', '2023-01-25', '2023-01-26',
               '2023-01-27', '2023-01-28', '2023-01-29', '2023-01-30',
               '2023-01-31', '2023-02-01'],
              dtype='datetime64[ns]', length=1857, freq='D')
```

[350]:
```
missing_dates = all_dates[~all_dates.isin(usd["Date"])]
missing_dates_df = pd.DataFrame({'Date': missing_dates})
usd = pd.concat([usd, missing_dates_df], ignore_index=True)
usd.sort_values(by="Date", inplace=True)
usd.fillna(np.nan, inplace=True)
usd.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1857 entries, 0 to 1856
Data columns (total 8 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   Yıl        1857 non-null   float64
 1   Date       1857 non-null   datetime64[ns]
 2   USD_ALIŞ   1276 non-null   float64
 3   USD_SATIŞ  1276 non-null   float64
 4   EUR_ALIŞ   1276 non-null   float64
 5   EUR_SATIŞ  1276 non-null   float64
 6   GBP_ALIŞ   1276 non-null   float64
 7   GBP_SATIŞ  1276 non-null   float64
dtypes: datetime64[ns](1), float64(7)
memory usage: 116.2 KB
```

[351]:
```
volume = pd.read_csv("volume.csv")
```

[352]:
```
volume.head()
```

[352]:
```
  Posting date    Product                      Material Description  \
0   2019-01-01  400003756           BF AGO 10ppmS B0 Udy Mkd Turkey
1   2019-01-01  400003769   SH ULG 95 10ppmS E0 Udy Mkd FuelSave TR
2   2019-01-01  400003769   SH ULG 95 10ppmS E0 Udy Mkd FuelSave TR
3   2019-01-01  400003981  AGO 10ppmS B0 Udy Mkd FuelSave Diesel TR
4   2019-01-01  400003981  AGO 10ppmS B0 Udy Mkd FuelSave Diesel TR

                      Category  Sales Volumes in L15
0                Supply 310001           935955.0000
1  Shell Fleet Solutions 100018              82.0275
2            Undercanopy 800001            2268.0725
3  Shell Fleet Solutions 100018            4625.2275
4            Undercanopy 800001           39751.6400
```

[353]:
```
volume.columns
```

[353]:
```
Index(['Posting date', 'Product', 'Material Description', 'Category',
       'Sales Volumes in L15'],
      dtype='object')
```

[354]:
```
volume = volume.rename(columns={
    "Posting date":"Date",
    "Material Description":"Material_Description",
    "Sales Volumes in L15":"Sales_Volumes_in_L15"
})
```

[355]:
```
volume["Date"] = pd.to_datetime(volume["Date"])
```

[356]:
```
volume.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 149374 entries, 0 to 149373
Data columns (total 5 columns):
 #   Column                Non-Null Count   Dtype
---  ------                --------------   -----
 0   Date                  149374 non-null  datetime64[ns]
 1   Product               149374 non-null  int64
 2   Material_Description  149374 non-null  object
 3   Category              149374 non-null  object
 4   Sales_Volumes_in_L15  149374 non-null  float64
dtypes: datetime64[ns](1), float64(1), int64(1), object(2)
memory usage: 5.7+ MB
```

[357]:
```
unique_dates = volume["Date"].drop_duplicates()
all_dates = pd.date_range(start=unique_dates.min(), end=unique_dates.max())
```

```
all_dates
```

[357]:
```
DatetimeIndex(['2019-01-01', '2019-01-02', '2019-01-03', '2019-01-04',
               '2019-01-05', '2019-01-06', '2019-01-07', '2019-01-08',
               '2019-01-09', '2019-01-10',
               …
               '2023-01-23', '2023-01-24', '2023-01-25', '2023-01-26',
               '2023-01-27', '2023-01-28', '2023-01-29', '2023-01-30',
               '2023-01-31', '2023-02-01'],
              dtype='datetime64[ns]', length=1493, freq='D')
```

[358]:
```
missing_dates = all_dates[~all_dates.isin(volume["Date"])]
missing_dates_df = pd.DataFrame({'Date': missing_dates})
volume = pd.concat([volume, missing_dates_df], ignore_index=True)
volume.sort_values(by="Date", inplace=True)
volume.fillna(np.nan, inplace=True)
volume.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 149380 entries, 0 to 149277
Data columns (total 5 columns):
 #   Column                Non-Null Count   Dtype
---  ------                --------------   -----
 0   Date                  149380 non-null  datetime64[ns]
 1   Product               149374 non-null  float64
 2   Material_Description  149374 non-null  object
 3   Category              149374 non-null  object
 4   Sales_Volumes_in_L15  149374 non-null  float64
dtypes: datetime64[ns](1), float64(2), object(2)
memory usage: 6.8+ MB
```

[359]:
```
brent = pd.read_csv("brent.csv")
```

[360]:
```
brent.head()
```

[360]:

	Tarih	Ürün	Avrupa Birliği Para Birimi	AB Piyasa Fiyatı	AB Piyasa Fiyatı- Yüksek	AB Piyasa Fiyatı- Düşük	Dolar Kuru (Satış)
0	2023-02-01	ICE BRENT	$/BBL	82.84	86.21	82.37	18.8235
1	2023-01-31	ICE BRENT	$/BBL	84.49	85.25	83.73	18.8216
2	2023-01-30	ICE BRENT	$/BBL	84.90	87.48	84.66	18.8215
3	2023-01-29	ICE BRENT	$/BBL	86.66	88.95	85.69	18.8191
4	2023-01-28	ICE BRENT	$/BBL	86.66			

```
4                    88.95                    85.69             18.8191
```

[361]:
```
brent.columns
```

[361]:
```
Index(['Tarih', 'Ürün', 'Avrupa Birliği Para Birimi', 'AB Piyasa Fiyatı',
       'AB Piyasa Fiyatı- Yüksek', 'AB Piyasa Fiyatı- Düşük',
       'Dolar Kuru (Satış)'],
      dtype='object')
```

[362]:
```
brent = brent.rename(columns={
    "Tarih":"Date",
    "Avrupa Birliği Para Birimi":"Avrupa_Birliği_Para_Birimi(Brent)",
    "AB Piyasa Fiyatı":"AB_Piyasa_Fiyatı(Brent)",
    "AB Piyasa Fiyatı- Yüksek":"AB_Piyasa_Fiyatı_Yüksek(Brent)",
    "AB Piyasa Fiyatı- Düşük":"AB_Piyasa_Fiyatı_Düşük(Brent)",
    "Dolar Kuru (Satış)":"Dolar_Kuru(Satış)(Brent)"
})
```

[363]:
```
brent["Date"] = pd.to_datetime(brent["Date"])
```

[364]:
```
brent.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1857 entries, 0 to 1856
Data columns (total 7 columns):
 #   Column                              Non-Null Count  Dtype
---  ------                              --------------  -----
 0   Date                                1857 non-null   datetime64[ns]
 1   Ürün                                1857 non-null   object
 2   Avrupa_Birliği_Para_Birimi(Brent)   1857 non-null   object
 3   AB_Piyasa_Fiyatı(Brent)             1857 non-null   float64
 4   AB_Piyasa_Fiyatı_Yüksek(Brent)      1813 non-null   float64
 5   AB_Piyasa_Fiyatı_Düşük(Brent)       1813 non-null   float64
 6   Dolar_Kuru(Satış)(Brent)            1857 non-null   float64
dtypes: datetime64[ns](1), float64(4), object(2)
memory usage: 101.7+ KB
```

[365]:
```
unique_dates = brent["Date"].drop_duplicates()
all_dates = pd.date_range(start=unique_dates.min(), end=unique_dates.max())
all_dates
```

[365]:
```
DatetimeIndex(['2018-01-02', '2018-01-03', '2018-01-04', '2018-01-05',
               '2018-01-06', '2018-01-07', '2018-01-08', '2018-01-09',
               '2018-01-10', '2018-01-11',
               …
               '2023-01-23', '2023-01-24', '2023-01-25', '2023-01-26',
               '2023-01-27', '2023-01-28', '2023-01-29', '2023-01-30',
```

```
               '2023-01-31', '2023-02-01'],
              dtype='datetime64[ns]', length=1857, freq='D')
```

[366]:
```
missing_dates = all_dates[~all_dates.isin(brent["Date"])]
missing_dates_df = pd.DataFrame({'Date': missing_dates})
brent = pd.concat([brent, missing_dates_df], ignore_index=True)
brent.sort_values(by="Date", inplace=True)
brent.fillna(np.nan, inplace=True)
brent.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1857 entries, 1856 to 0
Data columns (total 7 columns):
 #   Column                              Non-Null Count  Dtype
---  ------                              --------------  -----
 0   Date                                1857 non-null   datetime64[ns]
 1   Ürün                                1857 non-null   object
 2   Avrupa_Birliği_Para_Birimi(Brent)   1857 non-null   object
 3   AB_Piyasa_Fiyatı(Brent)             1857 non-null   float64
 4   AB_Piyasa_Fiyatı_Yüksek(Brent)      1813 non-null   float64
 5   AB_Piyasa_Fiyatı_Düşük(Brent)       1813 non-null   float64
 6   Dolar_Kuru(Satış)(Brent)            1857 non-null   float64
dtypes: datetime64[ns](1), float64(4), object(2)
memory usage: 116.1+ KB
```

[367]:
```
cash_flow_train = pd.read_csv("cash_flow_train.csv")
```

[368]:
```
cash_flow_train.head()
```

[368]:

	Date	Total Inflows	Customers - DDS	Customers - EFT	\
0	2019-01-02	1.747050e+07	7718750.0	9.655500e+06	
1	2019-01-03	1.153048e+07	3431500.0	8.098978e+06	
2	2019-01-04	2.591328e+07	13775750.0	1.213753e+07	
3	2019-01-07	5.259345e+07	39041750.0	1.355170e+07	
4	2019-01-08	3.650429e+07	15137500.0	2.136679e+07	

	T&S Collections	FX Sales	Other operations	Total Outflows	Tüpraş	\
0	0.0	0.0	96250.0	-4.631593e+07	-1.457022e+07	
1	0.0	0.0	0.0	-1.535349e+07	-1.337181e+07	
2	0.0	0.0	0.0	-1.098651e+08	-2.459390e+07	
3	0.0	0.0	0.0	-5.165489e+07	-3.110594e+07	
4	0.0	0.0	0.0	-1.842178e+07	-1.246099e+07	

	Other Oil	Gas	Import payments (FX purchases)	Tax	\
0	-144151.00	-1.109963e+06	-29274250.0	-1.048839e+05	
1	-300799.25	-2.798575e+05	-7746.0	-7.887853e+05	
2	0.00	0.000000e+00	-49032605.0	-2.936467e+06	

```
3 -3364373.00 -1.406590e+06                    -12049750.0 -8.218624e+05
4   -16765.25 -4.078995e+05                       -67702.5 -4.438174e+06

   Operatioınal and Admin. Expenses  VIS Buyback Payments  \
0                      -1112468.950          0.000000e+00
1                       -604485.735          0.000000e+00
2                      -7175889.980         -2.612621e+07
3                      -2906374.810          0.000000e+00
4                      -1030240.720          0.000000e+00

   Net Cashflow from Operations  Inflows- currency
0                 -2.884543e+07                NaN
1                 -3.823007e+06                NaN
2                 -8.395180e+07                NaN
3                  9.385578e+05                NaN
4                  1.808252e+07                NaN
```

[369]:
```
cash_flow_train.columns
```

[369]:
```
Index(['Date', 'Total Inflows', 'Customers - DDS', 'Customers - EFT',
       'T&S Collections', 'FX Sales', 'Other operations', 'Total Outflows',
       'Tüpraş', 'Other Oil', 'Gas', 'Import payments (FX purchases)', 'Tax',
       'Operatioınal and Admin. Expenses', 'VIS Buyback Payments',
       'Net Cashflow from Operations', 'Inflows- currency'],
      dtype='object')
```

[370]:
```
cash_flow_train = cash_flow_train.rename(columns={
    'Total Inflows':"Total_Inflows",
    'Customers - DDS':"Customers_DDS",
    'Customers - EFT':"Customers_EFT",
    'T&S Collections':"T&S Collections",
    'FX Sales':"FX_Sales",
    'Other operations':"Other_Operations",
    'Total Outflows':"Total_Outflows",
    'Other Oil':"Other_Oil",
    'Import payments (FX purchases)':"Import_Payments(FX_Purchases)",
    'Operatioınal and Admin. Expenses':"Operational_And_Admin._Expenses",
    'VIS Buyback Payments':"VIS_Buyback_Payments",
    'Net Cashflow from Operations':"Net_Cashflow_From_Operations",
    'Inflows- currency':"Inflows_Currency"
})
```

[371]:
```
cash_flow_train["Date"] = pd.to_datetime(cash_flow_train["Date"])
```

[372]:
```
cash_flow_train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
```

```
RangeIndex: 1025 entries, 0 to 1024
Data columns (total 17 columns):
 #   Column                            Non-Null Count  Dtype
---  ------                            --------------  -----
 0   Date                              1025 non-null   datetime64[ns]
 1   Total_Inflows                     1025 non-null   float64
 2   Customers_DDS                     1025 non-null   float64
 3   Customers_EFT                     1025 non-null   float64
 4   T&S Collections                   1025 non-null   float64
 5   FX_Sales                          1025 non-null   float64
 6   Other_Operations                  1025 non-null   float64
 7   Total_Outflows                    1025 non-null   float64
 8   Tüpraş                            1025 non-null   float64
 9   Other_Oil                         1025 non-null   float64
 10  Gas                               1025 non-null   float64
 11  Import_Payments(FX_Purchases)     1025 non-null   float64
 12  Tax                               1025 non-null   float64
 13  Operational_And_Admin._Expenses   1025 non-null   float64
 14  VIS_Buyback_Payments              1025 non-null   float64
 15  Net_Cashflow_From_Operations      1025 non-null   float64
 16  Inflows_Currency                  524 non-null    float64
dtypes: datetime64[ns](1), float64(16)
memory usage: 136.3 KB
```

[373]:
```
unique_dates = cash_flow_train["Date"].drop_duplicates()
all_dates = pd.date_range(start=unique_dates.min(), end=unique_dates.max())
all_dates
```

[373]:
```
DatetimeIndex(['2019-01-02', '2019-01-03', '2019-01-04', '2019-01-05',
               '2019-01-06', '2019-01-07', '2019-01-08', '2019-01-09',
               '2019-01-10', '2019-01-11',
               …
               '2023-01-23', '2023-01-24', '2023-01-25', '2023-01-26',
               '2023-01-27', '2023-01-28', '2023-01-29', '2023-01-30',
               '2023-01-31', '2023-02-01'],
              dtype='datetime64[ns]', length=1492, freq='D')
```

[374]:
```
missing_dates = all_dates[~all_dates.isin(cash_flow_train["Date"])]
missing_dates_df = pd.DataFrame({'Date': missing_dates})
cash_flow_train = pd.concat([cash_flow_train, missing_dates_df],␣
 ↪ignore_index=True)
cash_flow_train.sort_values(by="Date", inplace=True)
cash_flow_train.fillna(np.nan, inplace=True)
cash_flow_train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1492 entries, 0 to 1024
Data columns (total 17 columns):
```

```
 #   Column                          Non-Null Count  Dtype
---  ------                          --------------  -----
 0   Date                            1492 non-null   datetime64[ns]
 1   Total_Inflows                   1025 non-null   float64
 2   Customers_DDS                   1025 non-null   float64
 3   Customers_EFT                   1025 non-null   float64
 4   T&S Collections                 1025 non-null   float64
 5   FX_Sales                        1025 non-null   float64
 6   Other_Operations                1025 non-null   float64
 7   Total_Outflows                  1025 non-null   float64
 8   Tüpraş                          1025 non-null   float64
 9   Other_Oil                       1025 non-null   float64
 10  Gas                             1025 non-null   float64
 11  Import_Payments(FX_Purchases)   1025 non-null   float64
 12  Tax                             1025 non-null   float64
 13  Operational_And_Admin._Expenses 1025 non-null   float64
 14  VIS_Buyback_Payments            1025 non-null   float64
 15  Net_Cashflow_From_Operations    1025 non-null   float64
 16  Inflows_Currency                524 non-null    float64
dtypes: datetime64[ns](1), float64(16)
memory usage: 209.8 KB
```

[375]:
```
depo_pump_imm = pd.read_csv("depo_pump_imm.csv")
```

[376]:
```
depo_pump_imm.head()
```

[376]:

	Yıl	Ay	IMM TL/m3	Pump Price	Depot Price
0	2018	1	596,79	5,28	4.149,81
1	2018	2	606,58	5,23	4.110,32
2	2018	3	610,44	5,32	4.195,51
3	2018	4	608,02	5,62	4.449,25
4	2018	5	574,56	5,77	4.605,51

[377]:
```
depo_pump_imm["Date"] = pd.to_datetime(depo_pump_imm['Yıl'].astype(str) + '-' +␣
↪depo_pump_imm['Ay'].astype(str) + '-01')
```

[378]:
```
depo_pump_imm.head()
```

[378]:

	Yıl	Ay	IMM TL/m3	Pump Price	Depot Price	Date
0	2018	1	596,79	5,28	4.149,81	2018-01-01
1	2018	2	606,58	5,23	4.110,32	2018-02-01
2	2018	3	610,44	5,32	4.195,51	2018-03-01
3	2018	4	608,02	5,62	4.449,25	2018-04-01
4	2018	5	574,56	5,77	4.605,51	2018-05-01

[379]:
```
depo_pump_imm.columns
```

[379]:
```
Index(['Yıl', 'Ay', 'IMM TL/m3', 'Pump Price', 'Depot Price', 'Date'],
dtype='object')
```

[380]:
```
depo_pump_imm = depo_pump_imm.rename(columns={
    'IMM TL/m3':"IMM_TL/m3",
    'Pump Price':"Pump_Price",
    'Depot Price':"Depot_Price"
})
```

[381]:
```
depo_pump_imm["Date"] = pd.to_datetime(depo_pump_imm["Date"])
```

[382]:
```
depo_pump_imm.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 60 entries, 0 to 59
Data columns (total 6 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   Yıl          60 non-null     int64
 1   Ay           60 non-null     int64
 2   IMM_TL/m3    60 non-null     object
 3   Pump_Price   60 non-null     object
 4   Depot_Price  60 non-null     object
 5   Date         60 non-null     datetime64[ns]
dtypes: datetime64[ns](1), int64(2), object(3)
memory usage: 2.9+ KB
```

[383]:
```
unique_dates = depo_pump_imm["Date"].drop_duplicates()
all_dates = pd.date_range(start=unique_dates.min(), end="2022-12-31")
all_dates
```

[383]:
```
DatetimeIndex(['2018-01-01', '2018-01-02', '2018-01-03', '2018-01-04',
               '2018-01-05', '2018-01-06', '2018-01-07', '2018-01-08',
               '2018-01-09', '2018-01-10',
               …
               '2022-12-22', '2022-12-23', '2022-12-24', '2022-12-25',
               '2022-12-26', '2022-12-27', '2022-12-28', '2022-12-29',
               '2022-12-30', '2022-12-31'],
              dtype='datetime64[ns]', length=1826, freq='D')
```

[384]:
```
missing_dates = all_dates[~all_dates.isin(depo_pump_imm["Date"])]
missing_dates_df = pd.DataFrame({'Date': missing_dates})
depo_pump_imm = pd.concat([depo_pump_imm, missing_dates_df], ignore_index=True)
depo_pump_imm.sort_values(by="Date", inplace=True)
depo_pump_imm.fillna(np.nan, inplace=True)
depo_pump_imm.info()
```

```
<class 'pandas.core.frame.DataFrame'>
```

```
Index: 1826 entries, 0 to 1825
Data columns (total 6 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   Yıl          60 non-null     float64
 1   Ay           60 non-null     float64
 2   IMM_TL/m3    60 non-null     object
 3   Pump_Price   60 non-null     object
 4   Depot_Price  60 non-null     object
 5   Date         1826 non-null   datetime64[ns]
dtypes: datetime64[ns](1), float64(2), object(3)
memory usage: 99.9+ KB
```

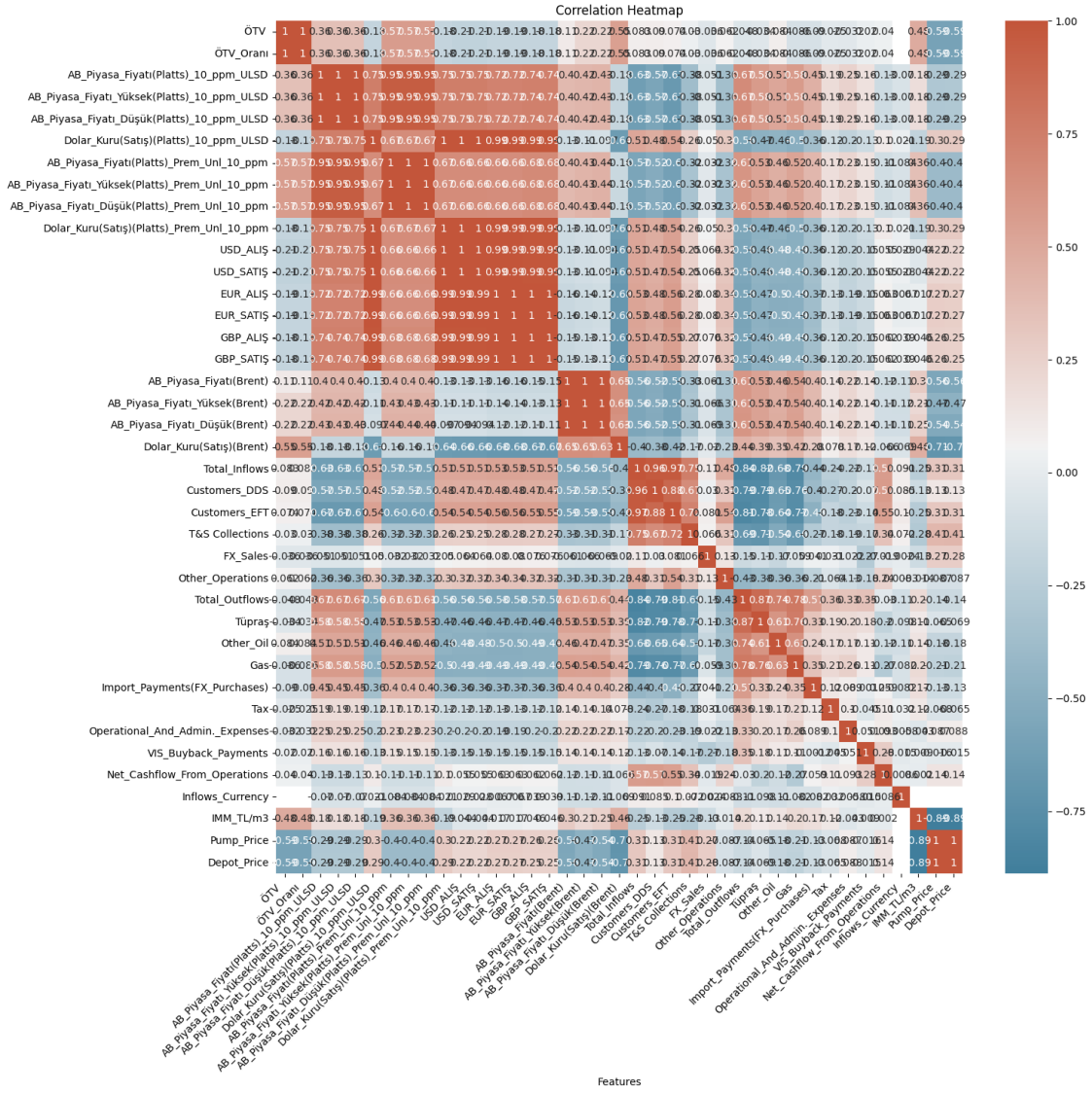
[385]:
```
platts.columns
```

[385]:
```
Index(['Date', 'Avrupa_Birliği_Birimi(Platts)',
       'AB_Piyasa_Fiyatı(Platts)_10_ppm_ULSD',
       'AB_Piyasa_Fiyatı_Yüksek(Platts)_10_ppm_ULSD',
       'AB_Piyasa_Fiyatı_Düşük(Platts)_10_ppm_ULSD',
       'Dolar_Kuru(Satış)(Platts)_10_ppm_ULSD',
       'AB_Piyasa_Fiyatı(Platts)_Prem_Unl_10_ppm',
       'AB_Piyasa_Fiyatı_Yüksek(Platts)_Prem_Unl_10_ppm',
       'AB_Piyasa_Fiyatı_Düşük(Platts)_Prem_Unl_10_ppm',
       'Dolar_Kuru(Satış)(Platts)_Prem_Unl_10_ppm'],
      dtype='object')
```

[386]:
```
merged_data = pd.concat([otv[['ÖTV␣
↪','ÖTV_Oranı']],platts[['AB_Piyasa_Fiyatı(Platts)_10_ppm_ULSD',
       'AB_Piyasa_Fiyatı_Yüksek(Platts)_10_ppm_ULSD',
       'AB_Piyasa_Fiyatı_Düşük(Platts)_10_ppm_ULSD',
       'Dolar_Kuru(Satış)(Platts)_10_ppm_ULSD',
       'AB_Piyasa_Fiyatı(Platts)_Prem_Unl_10_ppm',
       'AB_Piyasa_Fiyatı_Yüksek(Platts)_Prem_Unl_10_ppm',
       'AB_Piyasa_Fiyatı_Düşük(Platts)_Prem_Unl_10_ppm',
       'Dolar_Kuru(Satış)(Platts)_Prem_Unl_10_ppm']],
                          ␣
↪usd[["USD_ALIŞ","USD_SATIŞ","EUR_ALIŞ","EUR_SATIŞ","GBP_ALIŞ",
                                "GBP_SATIŞ"]],brent[[
                                     "AB_Piyasa_Fiyatı(Brent)",
                                     "AB_Piyasa_Fiyatı_Yüksek(Brent)",
                                     "AB_Piyasa_Fiyatı_Düşük(Brent)",
                                    ␣
↪"Dolar_Kuru(Satış)(Brent)"]],cash_flow_train[[
                                              ␣
↪"Total_Inflows","Customers_DDS","Customers_EFT",
                                                "T&S␣
↪Collections","FX_Sales","Other_Operations",
```

```
                                                ␣
↪"Total_Outflows","Tüpraş","Other_Oil","Gas",
                                                 "Import_Payments(FX_Purchases)","Tax",
                                                 "Operational_And_Admin._Expenses",
                                                 "VIS_Buyback_Payments",
                                                ␣
↪"Net_Cashflow_From_Operations","Inflows_Currency"]],
                                      depo_pump_imm[["IMM_TL/
↪m3","Pump_Price","Depot_Price"]]],
                          axis=1)
```

[387]:
```
merged_data = merged_data.apply(lambda x: x.str.replace(',', '').astype(float)␣
 ↪if x.dtype == "object" else x)
correlation_matrix = merged_data.corr()
plt.figure(figsize=(15,15))
sns.heatmap(correlation_matrix, annot=True, cmap=sns.diverging_palette(230, 20,␣
 ↪as_cmap=True))
plt.xticks(rotation=45, ha='right')
plt.title('Correlation Heatmap')
plt.xlabel('Features')
plt.show()
```



[ ]:
```
correlation_df = pd.DataFrame(correlation_matrix)
correlation_df
```

[ ]:
```
filtered_corr_matrix = correlation_matrix[(correlation_matrix > 0.5) |␣
↪(correlation_matrix < -0.5)]
filtered_corr_matrix
```

[390]:
```
usd.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1857 entries, 0 to 1856
Data columns (total 8 columns):
 #   Column     Non-Null Count  Dtype
```

```
---  ------     --------------  -----
 0   Yıl        1857 non-null   float64
 1   Date       1857 non-null   datetime64[ns]
 2   USD_ALIŞ   1276 non-null   float64
 3   USD_SATIŞ  1276 non-null   float64
 4   EUR_ALIŞ   1276 non-null   float64
 5   EUR_SATIŞ  1276 non-null   float64
 6   GBP_ALIŞ   1276 non-null   float64
 7   GBP_SATIŞ  1276 non-null   float64
dtypes: datetime64[ns](1), float64(7)
memory usage: 116.2 KB
```

[391]:
```
merged_data_2 = pd.
 ↪merge(platts[["Date","AB_Piyasa_Fiyatı(Platts)_10_ppm_ULSD","AB_Piyasa_Fiyatı_Yüksek(Platts
merged_data_2 = pd.merge(merged_data_2,␣
 ↪cash_flow_train[["Date","Total_Inflows","Customers_EFT","Total_Outflows"]],on="Date",how="o
merged_data_2 = pd.merge(merged_data_2, usd[["Date",'USD_ALIŞ', 'USD_SATIŞ',␣
 ↪'EUR_ALIŞ', 'EUR_SATIŞ','GBP_ALIŞ', 'GBP_SATIŞ']],on="Date",how="outer")
merged_data_2 = merged_data_2.sort_values('Date')
merged_data_2 = merged_data_2.drop_duplicates()
merged_data_2 = merged_data_2.reset_index(drop=True)
merged_data_2 = merged_data_2.apply(lambda x: x.str.replace(',', '').
 ↪astype(float) if x.dtype == "object" else x)
merged_data_2.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1857 entries, 0 to 1856
Data columns (total 20 columns):
 #   Column                                      Non-Null Count  Dtype
---  ------                                      --------------  -----
 0   Date                                        1857 non-null
datetime64[ns]
 1   AB_Piyasa_Fiyatı(Platts)_10_ppm_ULSD        1825 non-null   float64
 2   AB_Piyasa_Fiyatı_Yüksek(Platts)_10_ppm_ULSD 1825 non-null   float64
 3   AB_Piyasa_Fiyatı_Düşük(Platts)_10_ppm_ULSD  1825 non-null   float64
 4   Dolar_Kuru(Satış)(Platts)_10_ppm_ULSD       1825 non-null   float64
 5   AB_Piyasa_Fiyatı(Platts)_Prem_Unl_10_ppm    1825 non-null   float64
 6   AB_Piyasa_Fiyatı_Yüksek(Platts)_Prem_Unl_10_ppm 1825 non-null   float64
 7   AB_Piyasa_Fiyatı_Düşük(Platts)_Prem_Unl_10_ppm  1825 non-null   float64
 8   Dolar_Kuru(Satış)(Platts)_Prem_Unl_10_ppm   1825 non-null   float64
 9   AB_Piyasa_Fiyatı_Düşük(Brent)               1813 non-null   float64
 10  Dolar_Kuru(Satış)(Brent)                    1857 non-null   float64
 11  Total_Inflows                               1025 non-null   float64
 12  Customers_EFT                               1025 non-null   float64
 13  Total_Outflows                              1025 non-null   float64
 14  USD_ALIŞ                                    1276 non-null   float64
 15  USD_SATIŞ                                   1276 non-null   float64
```

```
 16  EUR_ALIŞ                                          1276 non-null   float64
 17  EUR_SATIŞ                                         1276 non-null   float64
 18  GBP_ALIŞ                                          1276 non-null   float64
 19  GBP_SATIŞ                                         1276 non-null   float64
dtypes: datetime64[ns](1), float64(19)
memory usage: 290.3 KB
```

[392]:
```
merged_data_3 = merged_data_2.dropna()
merged_data_3.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 978 entries, 365 to 1823
Data columns (total 20 columns):
 #   Column                                          Non-Null Count  Dtype
---  ------                                          --------------  -----
 0   Date                                            978 non-null
datetime64[ns]
 1   AB_Piyasa_Fiyatı(Platts)_10_ppm_ULSD            978 non-null    float64
 2   AB_Piyasa_Fiyatı_Yüksek(Platts)_10_ppm_ULSD     978 non-null    float64
 3   AB_Piyasa_Fiyatı_Düşük(Platts)_10_ppm_ULSD      978 non-null    float64
 4   Dolar_Kuru(Satış)(Platts)_10_ppm_ULSD           978 non-null    float64
 5   AB_Piyasa_Fiyatı(Platts)_Prem_Unl_10_ppm        978 non-null    float64
 6   AB_Piyasa_Fiyatı_Yüksek(Platts)_Prem_Unl_10_ppm 978 non-null    float64
 7   AB_Piyasa_Fiyatı_Düşük(Platts)_Prem_Unl_10_ppm  978 non-null    float64
 8   Dolar_Kuru(Satış)(Platts)_Prem_Unl_10_ppm       978 non-null    float64
 9   AB_Piyasa_Fiyatı_Düşük(Brent)                   978 non-null    float64
 10  Dolar_Kuru(Satış)(Brent)                        978 non-null    float64
 11  Total_Inflows                                   978 non-null    float64
 12  Customers_EFT                                   978 non-null    float64
 13  Total_Outflows                                  978 non-null    float64
 14  USD_ALIŞ                                        978 non-null    float64
 15  USD_SATIŞ                                       978 non-null    float64
 16  EUR_ALIŞ                                        978 non-null    float64
 17  EUR_SATIŞ                                       978 non-null    float64
 18  GBP_ALIŞ                                        978 non-null    float64
 19  GBP_SATIŞ                                       978 non-null    float64
dtypes: datetime64[ns](1), float64(19)
memory usage: 160.5 KB
```

[393]:
```
merged_data_4 = merged_data_2[merged_data_2["EUR_ALIŞ"].isnull()]
merged_data_4.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 581 entries, 4 to 1853
Data columns (total 20 columns):
 #   Column                                          Non-Null Count  Dtype
---  ------                                          --------------  -----
 0   Date                                            581 non-null
```

```
datetime64[ns]
 1   AB_Piyasa_Fiyatı(Platts)_10_ppm_ULSD             572 non-null    float64
 2   AB_Piyasa_Fiyatı_Yüksek(Platts)_10_ppm_ULSD      572 non-null    float64
 3   AB_Piyasa_Fiyatı_Düşük(Platts)_10_ppm_ULSD       572 non-null    float64
 4   Dolar_Kuru(Satış)(Platts)_10_ppm_ULSD            572 non-null    float64
 5   AB_Piyasa_Fiyatı(Platts)_Prem_Unl_10_ppm         572 non-null    float64
 6   AB_Piyasa_Fiyatı_Yüksek(Platts)_Prem_Unl_10_ppm  572 non-null    float64
 7   AB_Piyasa_Fiyatı_Düşük(Platts)_Prem_Unl_10_ppm   572 non-null    float64
 8   Dolar_Kuru(Satış)(Platts)_Prem_Unl_10_ppm        572 non-null    float64
 9   AB_Piyasa_Fiyatı_Düşük(Brent)                    561 non-null    float64
 10  Dolar_Kuru(Satış)(Brent)                         581 non-null    float64
 11  Total_Inflows                                    0 non-null      float64
 12  Customers_EFT                                    0 non-null      float64
 13  Total_Outflows                                   0 non-null      float64
 14  USD_ALIŞ                                         0 non-null      float64
 15  USD_SATIŞ                                        0 non-null      float64
 16  EUR_ALIŞ                                         0 non-null      float64
 17  EUR_SATIŞ                                        0 non-null      float64
 18  GBP_ALIŞ                                         0 non-null      float64
 19  GBP_SATIŞ                                        0 non-null      float64
dtypes: datetime64[ns](1), float64(19)
memory usage: 95.3 KB
```

[394]:
```
X = merged_data_3["Dolar_Kuru(Satış)(Brent)"]
y = merged_data_3["EUR_ALIŞ"].dropna()
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
X_train = X_train.values.reshape(-1, 1)
X_test = X_test.values.reshape(-1, 1)
model = LinearRegression()
model.fit(X_train, y_train)
empty_lines = merged_data_2[merged_data_2["EUR_ALIŞ"].isnull()]
prediction = model.predict(empty_lines["Dolar_Kuru(Satış)(Brent)"].values.
 ↪reshape(-1, 1))
empty_lines_index = merged_data_2[merged_data_2["EUR_ALIŞ"].isnull()].index
merged_data_2.loc[empty_lines_index, "EUR_ALIŞ"] = prediction

X = merged_data_3["Dolar_Kuru(Satış)(Brent)"]
y = merged_data_3["EUR_SATIŞ"].dropna()
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
X_train = X_train.values.reshape(-1, 1)
X_test = X_test.values.reshape(-1, 1)
model = LinearRegression()
model.fit(X_train, y_train)
empty_lines = merged_data_2[merged_data_2["EUR_SATIŞ"].isnull()]
```

```
prediction = model.predict(empty_lines["Dolar_Kuru(Satış)(Brent)"].values.
 ↪reshape(-1, 1))
empty_lines_index = merged_data_2[merged_data_2["EUR_SATIŞ"].isnull()].index
merged_data_2.loc[empty_lines_index, "EUR_SATIŞ"] = prediction

X = merged_data_3["Dolar_Kuru(Satış)(Brent)"]
y = merged_data_3["USD_ALIŞ"].dropna()
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
X_train = X_train.values.reshape(-1, 1)
X_test = X_test.values.reshape(-1, 1)
model = LinearRegression()
model.fit(X_train, y_train)
empty_lines = merged_data_2[merged_data_2["USD_ALIŞ"].isnull()]
prediction = model.predict(empty_lines["Dolar_Kuru(Satış)(Brent)"].values.
 ↪reshape(-1, 1))
empty_lines_index = merged_data_2[merged_data_2["USD_ALIŞ"].isnull()].index
merged_data_2.loc[empty_lines_index, "USD_ALIŞ"] = prediction

X = merged_data_3["Dolar_Kuru(Satış)(Brent)"]
y = merged_data_3["USD_SATIŞ"].dropna()
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
X_train = X_train.values.reshape(-1, 1)
X_test = X_test.values.reshape(-1, 1)
model = LinearRegression()
model.fit(X_train, y_train)
empty_lines = merged_data_2[merged_data_2["USD_SATIŞ"].isnull()]
prediction = model.predict(empty_lines["Dolar_Kuru(Satış)(Brent)"].values.
 ↪reshape(-1, 1))
empty_lines_index = merged_data_2[merged_data_2["USD_SATIŞ"].isnull()].index
merged_data_2.loc[empty_lines_index, "USD_SATIŞ"] = prediction

X = merged_data_3["Dolar_Kuru(Satış)(Brent)"]
y = merged_data_3["GBP_ALIŞ"].dropna()
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
X_train = X_train.values.reshape(-1, 1)
X_test = X_test.values.reshape(-1, 1)
model = LinearRegression()
model.fit(X_train, y_train)
empty_lines = merged_data_2[merged_data_2["GBP_ALIŞ"].isnull()]
prediction = model.predict(empty_lines["Dolar_Kuru(Satış)(Brent)"].values.
 ↪reshape(-1, 1))
empty_lines_index = merged_data_2[merged_data_2["GBP_ALIŞ"].isnull()].index
merged_data_2.loc[empty_lines_index, "GBP_ALIŞ"] = prediction
```

```
X = merged_data_3["Dolar_Kuru(Satış)(Brent)"]
y = merged_data_3["GBP_SATIŞ"].dropna()
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
X_train = X_train.values.reshape(-1, 1)
X_test = X_test.values.reshape(-1, 1)
model = LinearRegression()
model.fit(X_train, y_train)
empty_lines = merged_data_2[merged_data_2["GBP_SATIŞ"].isnull()]
prediction = model.predict(empty_lines["Dolar_Kuru(Satış)(Brent)"].values.
 ↪reshape(-1, 1))
empty_lines_index = merged_data_2[merged_data_2["GBP_SATIŞ"].isnull()].index
merged_data_2.loc[empty_lines_index, "GBP_SATIŞ"] = prediction

merged_data_2.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1857 entries, 0 to 1856
Data columns (total 20 columns):
 #   Column                                      Non-Null Count  Dtype
---  ------                                      --------------  -----
 0   Date                                        1857 non-null
datetime64[ns]
 1   AB_Piyasa_Fiyatı(Platts)_10_ppm_ULSD        1825 non-null   float64
 2   AB_Piyasa_Fiyatı_Yüksek(Platts)_10_ppm_ULSD 1825 non-null   float64
 3   AB_Piyasa_Fiyatı_Düşük(Platts)_10_ppm_ULSD  1825 non-null   float64
 4   Dolar_Kuru(Satış)(Platts)_10_ppm_ULSD       1825 non-null   float64
 5   AB_Piyasa_Fiyatı(Platts)_Prem_Unl_10_ppm    1825 non-null   float64
 6   AB_Piyasa_Fiyatı_Yüksek(Platts)_Prem_Unl_10_ppm 1825 non-null   float64
 7   AB_Piyasa_Fiyatı_Düşük(Platts)_Prem_Unl_10_ppm  1825 non-null   float64
 8   Dolar_Kuru(Satış)(Platts)_Prem_Unl_10_ppm   1825 non-null   float64
 9   AB_Piyasa_Fiyatı_Düşük(Brent)               1813 non-null   float64
 10  Dolar_Kuru(Satış)(Brent)                    1857 non-null   float64
 11  Total_Inflows                               1025 non-null   float64
 12  Customers_EFT                               1025 non-null   float64
 13  Total_Outflows                              1025 non-null   float64
 14  USD_ALIŞ                                    1857 non-null   float64
 15  USD_SATIŞ                                   1857 non-null   float64
 16  EUR_ALIŞ                                    1857 non-null   float64
 17  EUR_SATIŞ                                   1857 non-null   float64
 18  GBP_ALIŞ                                    1857 non-null   float64
 19  GBP_SATIŞ                                   1857 non-null   float64
dtypes: datetime64[ns](1), float64(19)
memory usage: 290.3 KB
```

[395]:
```
usd.columns
```

[395]:
```
Index(['Yıl', 'Date', 'USD_ALIŞ', 'USD_SATIŞ', 'EUR_ALIŞ', 'EUR_SATIŞ',
       'GBP_ALIŞ', 'GBP_SATIŞ'],
      dtype='object')
```

[396]:
```
usd[['USD_ALIŞ', 'USD_SATIŞ', 'EUR_ALIŞ', 'EUR_SATIŞ','GBP_ALIŞ', 'GBP_SATIŞ']]␣
 ↪= merged_data_2[['USD_ALIŞ', 'USD_SATIŞ', 'EUR_ALIŞ',␣
 ↪'EUR_SATIŞ','GBP_ALIŞ', 'GBP_SATIŞ']]
usd.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1857 entries, 0 to 1856
Data columns (total 8 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   Yıl        1857 non-null   float64
 1   Date       1857 non-null   datetime64[ns]
 2   USD_ALIŞ   1857 non-null   float64
 3   USD_SATIŞ  1857 non-null   float64
 4   EUR_ALIŞ   1857 non-null   float64
 5   EUR_SATIŞ  1857 non-null   float64
 6   GBP_ALIŞ   1857 non-null   float64
 7   GBP_SATIŞ  1857 non-null   float64
dtypes: datetime64[ns](1), float64(7)
memory usage: 116.2 KB
```

[397]:
```
merged_data_5 = pd.
 ↪merge(platts[["Date","AB_Piyasa_Fiyatı(Platts)_10_ppm_ULSD","AB_Piyasa_Fiyatı_Yüksek(Platts
merged_data_5 = merged_data_5.sort_values('Date')
merged_data_5 = merged_data_5.drop_duplicates()
merged_data_5 = merged_data_5.reset_index(drop=True)
merged_data_5 = merged_data_5.apply(lambda x: x.str.replace(',', '').
 ↪astype(float) if x.dtype == "object" else x)
merged_data_5.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1857 entries, 0 to 1856
Data columns (total 11 columns):
 #   Column                                      Non-Null Count  Dtype
---  ------                                      --------------  -----
 0   Date                                        1857 non-null
datetime64[ns]
 1   AB_Piyasa_Fiyatı(Platts)_10_ppm_ULSD        1825 non-null   float64
 2   AB_Piyasa_Fiyatı_Yüksek(Platts)_10_ppm_ULSD 1825 non-null   float64
 3   AB_Piyasa_Fiyatı_Düşük(Platts)_10_ppm_ULSD  1825 non-null   float64
 4   Dolar_Kuru(Satış)(Platts)_10_ppm_ULSD       1825 non-null   float64
 5   AB_Piyasa_Fiyatı(Platts)_Prem_Unl_10_ppm    1825 non-null   float64
 6   AB_Piyasa_Fiyatı_Yüksek(Platts)_Prem_Unl_10_ppm 1825 non-null   float64
```

```
 7   AB_Piyasa_Fiyatı_Düşük(Platts)_Prem_Unl_10_ppm   1825 non-null   float64
 8   Dolar_Kuru(Satış)(Platts)_Prem_Unl_10_ppm        1825 non-null   float64
 9   AB_Piyasa_Fiyatı_Yüksek(Brent)                   1813 non-null   float64
 10  AB_Piyasa_Fiyatı_Düşük(Brent)                    1813 non-null   float64
dtypes: datetime64[ns](1), float64(10)
memory usage: 159.7 KB
```

[398]:
```
merged_data_6 = merged_data_5.dropna()
merged_data_6.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1781 entries, 0 to 1824
Data columns (total 11 columns):
 #   Column                                           Non-Null Count  Dtype
---  ------                                           --------------  -----
 0   Date                                             1781 non-null
datetime64[ns]
 1   AB_Piyasa_Fiyatı(Platts)_10_ppm_ULSD             1781 non-null   float64
 2   AB_Piyasa_Fiyatı_Yüksek(Platts)_10_ppm_ULSD      1781 non-null   float64
 3   AB_Piyasa_Fiyatı_Düşük(Platts)_10_ppm_ULSD       1781 non-null   float64
 4   Dolar_Kuru(Satış)(Platts)_10_ppm_ULSD            1781 non-null   float64
 5   AB_Piyasa_Fiyatı(Platts)_Prem_Unl_10_ppm         1781 non-null   float64
 6   AB_Piyasa_Fiyatı_Yüksek(Platts)_Prem_Unl_10_ppm  1781 non-null   float64
 7   AB_Piyasa_Fiyatı_Düşük(Platts)_Prem_Unl_10_ppm   1781 non-null   float64
 8   Dolar_Kuru(Satış)(Platts)_Prem_Unl_10_ppm        1781 non-null   float64
 9   AB_Piyasa_Fiyatı_Yüksek(Brent)                   1781 non-null   float64
 10  AB_Piyasa_Fiyatı_Düşük(Brent)                    1781 non-null   float64
dtypes: datetime64[ns](1), float64(10)
memory usage: 167.0 KB
```

[399]:
```
merged_data_7 = merged_data_5[merged_data_5["AB_Piyasa_Fiyatı_Yüksek(Brent)"].
  ↪isnull()]
merged_data_7.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 44 entries, 1519 to 1587
Data columns (total 11 columns):
 #   Column                                           Non-Null Count  Dtype
---  ------                                           --------------  -----
 0   Date                                             44 non-null
datetime64[ns]
 1   AB_Piyasa_Fiyatı(Platts)_10_ppm_ULSD             44 non-null     float64
 2   AB_Piyasa_Fiyatı_Yüksek(Platts)_10_ppm_ULSD      44 non-null     float64
 3   AB_Piyasa_Fiyatı_Düşük(Platts)_10_ppm_ULSD       44 non-null     float64
 4   Dolar_Kuru(Satış)(Platts)_10_ppm_ULSD            44 non-null     float64
 5   AB_Piyasa_Fiyatı(Platts)_Prem_Unl_10_ppm         44 non-null     float64
 6   AB_Piyasa_Fiyatı_Yüksek(Platts)_Prem_Unl_10_ppm  44 non-null     float64
 7   AB_Piyasa_Fiyatı_Düşük(Platts)_Prem_Unl_10_ppm   44 non-null     float64
```

```
 8   Dolar_Kuru(Satış)(Platts)_Prem_Unl_10_ppm        44 non-null     float64
 9   AB_Piyasa_Fiyatı_Yüksek(Brent)                   0 non-null      float64
 10  AB_Piyasa_Fiyatı_Düşük(Brent)                    0 non-null      float64
dtypes: datetime64[ns](1), float64(10)
memory usage: 4.1 KB
```

[400]:
```
X = merged_data_6[["AB_Piyasa_Fiyatı(Platts)_10_ppm_ULSD",
                   "AB_Piyasa_Fiyatı_Yüksek(Platts)_10_ppm_ULSD",
                   "AB_Piyasa_Fiyatı_Düşük(Platts)_10_ppm_ULSD",
                   "Dolar_Kuru(Satış)(Platts)_10_ppm_ULSD",
                   "AB_Piyasa_Fiyatı(Platts)_Prem_Unl_10_ppm",
                   "AB_Piyasa_Fiyatı_Yüksek(Platts)_Prem_Unl_10_ppm",
                   "AB_Piyasa_Fiyatı_Düşük(Platts)_Prem_Unl_10_ppm",
                   "Dolar_Kuru(Satış)(Platts)_Prem_Unl_10_ppm"]]
y = merged_data_6["AB_Piyasa_Fiyatı_Yüksek(Brent)"].dropna()
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
model = LinearRegression()
model.fit(X_train, y_train)
empty_lines = merged_data_5[merged_data_5["AB_Piyasa_Fiyatı_Yüksek(Brent)"].
 ↪isnull()]
if not empty_lines.empty:
    X_empty = empty_lines[["AB_Piyasa_Fiyatı(Platts)_10_ppm_ULSD",
                   "AB_Piyasa_Fiyatı_Yüksek(Platts)_10_ppm_ULSD",
                   "AB_Piyasa_Fiyatı_Düşük(Platts)_10_ppm_ULSD",
                   "Dolar_Kuru(Satış)(Platts)_10_ppm_ULSD",
                   "AB_Piyasa_Fiyatı(Platts)_Prem_Unl_10_ppm",
                   "AB_Piyasa_Fiyatı_Yüksek(Platts)_Prem_Unl_10_ppm",
                   "AB_Piyasa_Fiyatı_Düşük(Platts)_Prem_Unl_10_ppm",
                   "Dolar_Kuru(Satış)(Platts)_Prem_Unl_10_ppm"]]
    prediction = model.predict(X_empty)
    empty_lines_index = empty_lines.index
    merged_data_5.loc[empty_lines_index, "AB_Piyasa_Fiyatı_Yüksek(Brent)"] =␣
 ↪prediction

X = merged_data_6[["AB_Piyasa_Fiyatı(Platts)_10_ppm_ULSD",
                   "AB_Piyasa_Fiyatı_Yüksek(Platts)_10_ppm_ULSD",
                   "AB_Piyasa_Fiyatı_Düşük(Platts)_10_ppm_ULSD",
                   "Dolar_Kuru(Satış)(Platts)_10_ppm_ULSD",
                   "AB_Piyasa_Fiyatı(Platts)_Prem_Unl_10_ppm",
                   "AB_Piyasa_Fiyatı_Yüksek(Platts)_Prem_Unl_10_ppm",
                   "AB_Piyasa_Fiyatı_Düşük(Platts)_Prem_Unl_10_ppm",
                   "Dolar_Kuru(Satış)(Platts)_Prem_Unl_10_ppm"]]
y = merged_data_6["AB_Piyasa_Fiyatı_Düşük(Brent)"].dropna()
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
model = LinearRegression()
```

```
model.fit(X_train, y_train)
empty_lines = merged_data_5[merged_data_5["AB_Piyasa_Fiyatı_Düşük(Brent)"].
 ↪isnull()]
if not empty_lines.empty:
    X_empty = empty_lines[["AB_Piyasa_Fiyatı(Platts)_10_ppm_ULSD",
                   "AB_Piyasa_Fiyatı_Yüksek(Platts)_10_ppm_ULSD",
                   "AB_Piyasa_Fiyatı_Düşük(Platts)_10_ppm_ULSD",
                   "Dolar_Kuru(Satış)(Platts)_10_ppm_ULSD",
                   "AB_Piyasa_Fiyatı(Platts)_Prem_Unl_10_ppm",
                   "AB_Piyasa_Fiyatı_Yüksek(Platts)_Prem_Unl_10_ppm",
                   "AB_Piyasa_Fiyatı_Düşük(Platts)_Prem_Unl_10_ppm",
                   "Dolar_Kuru(Satış)(Platts)_Prem_Unl_10_ppm"]]
    prediction = model.predict(X_empty)
    empty_lines_index = empty_lines.index
    merged_data_5.loc[empty_lines_index, "AB_Piyasa_Fiyatı_Düşük(Brent)"] =␣
 ↪prediction

merged_data_5.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1857 entries, 0 to 1856
Data columns (total 11 columns):
 #   Column                                        Non-Null Count  Dtype
---  ------                                        --------------  -----
 0   Date                                          1857 non-null
datetime64[ns]
 1   AB_Piyasa_Fiyatı(Platts)_10_ppm_ULSD          1825 non-null   float64
 2   AB_Piyasa_Fiyatı_Yüksek(Platts)_10_ppm_ULSD   1825 non-null   float64
 3   AB_Piyasa_Fiyatı_Düşük(Platts)_10_ppm_ULSD    1825 non-null   float64
 4   Dolar_Kuru(Satış)(Platts)_10_ppm_ULSD         1825 non-null   float64
 5   AB_Piyasa_Fiyatı(Platts)_Prem_Unl_10_ppm      1825 non-null   float64
 6   AB_Piyasa_Fiyatı_Yüksek(Platts)_Prem_Unl_10_ppm 1825 non-null   float64
 7   AB_Piyasa_Fiyatı_Düşük(Platts)_Prem_Unl_10_ppm 1825 non-null   float64
 8   Dolar_Kuru(Satış)(Platts)_Prem_Unl_10_ppm     1825 non-null   float64
 9   AB_Piyasa_Fiyatı_Yüksek(Brent)                1857 non-null   float64
 10  AB_Piyasa_Fiyatı_Düşük(Brent)                 1857 non-null   float64
dtypes: datetime64[ns](1), float64(10)
memory usage: 159.7 KB
```

[401]:
```
brent["AB_Piyasa_Fiyatı_Yüksek(Brent)"] =␣
 ↪merged_data_5["AB_Piyasa_Fiyatı_Yüksek(Brent)"]
brent["AB_Piyasa_Fiyatı_Düşük(Brent)"] =␣
 ↪merged_data_5["AB_Piyasa_Fiyatı_Düşük(Brent)"]
brent.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1857 entries, 1856 to 0
```

```
Data columns (total 7 columns):
 #   Column                                Non-Null Count  Dtype
---  ------                                --------------  -----
 0   Date                                  1857 non-null   datetime64[ns]
 1   Ürün                                  1857 non-null   object
 2   Avrupa_Birliği_Para_Birimi(Brent)     1857 non-null   object
 3   AB_Piyasa_Fiyatı(Brent)               1857 non-null   float64
 4   AB_Piyasa_Fiyatı_Yüksek(Brent)        1857 non-null   float64
 5   AB_Piyasa_Fiyatı_Düşük(Brent)         1857 non-null   float64
 6   Dolar_Kuru(Satış)(Brent)              1857 non-null   float64
dtypes: datetime64[ns](1), float64(4), object(2)
memory usage: 180.6+ KB
```

[402]:
```
merged_data_8 = pd.
  ↪merge(cash_flow_train[["Date","Inflows_Currency"]],brent[["Date","AB_Piyasa_Fiyatı(Brent)",
merged_data_8 = merged_data_8.sort_values('Date')
merged_data_8 = merged_data_8.drop_duplicates()
merged_data_8 = merged_data_8.reset_index(drop=True)
merged_data_8 = merged_data_8.apply(lambda x: x.str.replace(',', '').
  ↪astype(float) if x.dtype == "object" else x)
merged_data_8.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1857 entries, 0 to 1856
Data columns (total 5 columns):
 #   Column                          Non-Null Count  Dtype
---  ------                          --------------  -----
 0   Date                            1857 non-null   datetime64[ns]
 1   Inflows_Currency                524 non-null    float64
 2   AB_Piyasa_Fiyatı(Brent)         1857 non-null   float64
 3   AB_Piyasa_Fiyatı_Yüksek(Brent)  1857 non-null   float64
 4   AB_Piyasa_Fiyatı_Düşük(Brent)   1857 non-null   float64
dtypes: datetime64[ns](1), float64(4)
memory usage: 72.7 KB
```

[403]:
```
merged_data_9 = merged_data_8.dropna()
merged_data_9.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 524 entries, 1098 to 1856
Data columns (total 5 columns):
 #   Column                          Non-Null Count  Dtype
---  ------                          --------------  -----
 0   Date                            524 non-null    datetime64[ns]
 1   Inflows_Currency                524 non-null    float64
 2   AB_Piyasa_Fiyatı(Brent)         524 non-null    float64
 3   AB_Piyasa_Fiyatı_Yüksek(Brent)  524 non-null    float64
 4   AB_Piyasa_Fiyatı_Düşük(Brent)   524 non-null    float64
```

```
dtypes: datetime64[ns](1), float64(4)
memory usage: 24.6 KB
```

[404]:
```
merged_data_10 = merged_data_8[merged_data_8["Inflows_Currency"].isnull()]
merged_data_10.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1333 entries, 0 to 1853
Data columns (total 5 columns):
 #   Column                          Non-Null Count  Dtype
---  ------                          --------------  -----
 0   Date                            1333 non-null   datetime64[ns]
 1   Inflows_Currency                0 non-null      float64
 2   AB_Piyasa_Fiyatı(Brent)         1333 non-null   float64
 3   AB_Piyasa_Fiyatı_Yüksek(Brent)  1333 non-null   float64
 4   AB_Piyasa_Fiyatı_Düşük(Brent)   1333 non-null   float64
dtypes: datetime64[ns](1), float64(4)
memory usage: 62.5 KB
```

[405]:
```
X =␣
 ↪merged_data_9[["AB_Piyasa_Fiyatı(Brent)","AB_Piyasa_Fiyatı_Yüksek(Brent)","AB_Piyasa_Fiyatı
y = merged_data_9["Inflows_Currency"].dropna()
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
model = LinearRegression()
model.fit(X_train, y_train)
empty_lines = merged_data_8[merged_data_8["Inflows_Currency"].isnull()]
if not empty_lines.empty:
    X_empty =␣
 ↪empty_lines[["AB_Piyasa_Fiyatı(Brent)","AB_Piyasa_Fiyatı_Yüksek(Brent)","AB_Piyasa_Fiyatı_D
    prediction = model.predict(X_empty)
    empty_lines_index = empty_lines.index
    merged_data_8.loc[empty_lines_index, "Inflows_Currency"] = prediction

merged_data_8.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1857 entries, 0 to 1856
Data columns (total 5 columns):
 #   Column                          Non-Null Count  Dtype
---  ------                          --------------  -----
 0   Date                            1857 non-null   datetime64[ns]
 1   Inflows_Currency                1857 non-null   float64
 2   AB_Piyasa_Fiyatı(Brent)         1857 non-null   float64
 3   AB_Piyasa_Fiyatı_Yüksek(Brent)  1857 non-null   float64
 4   AB_Piyasa_Fiyatı_Düşük(Brent)   1857 non-null   float64
dtypes: datetime64[ns](1), float64(4)
memory usage: 72.7 KB
```

[406]:
```
cash_flow_train["Inflows_Currency"] = merged_data_8["Inflows_Currency"]
cash_flow_train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1492 entries, 0 to 1024
Data columns (total 17 columns):
 #   Column                            Non-Null Count  Dtype
---  ------                            --------------  -----
 0   Date                              1492 non-null   datetime64[ns]
 1   Total_Inflows                     1025 non-null   float64
 2   Customers_DDS                     1025 non-null   float64
 3   Customers_EFT                     1025 non-null   float64
 4   T&S Collections                   1025 non-null   float64
 5   FX_Sales                          1025 non-null   float64
 6   Other_Operations                  1025 non-null   float64
 7   Total_Outflows                    1025 non-null   float64
 8   Tüpraş                            1025 non-null   float64
 9   Other_Oil                         1025 non-null   float64
 10  Gas                               1025 non-null   float64
 11  Import_Payments(FX_Purchases)     1025 non-null   float64
 12  Tax                               1025 non-null   float64
 13  Operational_And_Admin._Expenses   1025 non-null   float64
 14  VIS_Buyback_Payments              1025 non-null   float64
 15  Net_Cashflow_From_Operations      1025 non-null   float64
 16  Inflows_Currency                  1492 non-null   float64
dtypes: datetime64[ns](1), float64(16)
memory usage: 242.1 KB
```

[ ]:
```
cash_flow_train["Date"]
```

[408]:
```
cash_flow_train = cash_flow_train.dropna()
cash_flow_train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1025 entries, 0 to 1024
Data columns (total 17 columns):
 #   Column                            Non-Null Count  Dtype
---  ------                            --------------  -----
 0   Date                              1025 non-null   datetime64[ns]
 1   Total_Inflows                     1025 non-null   float64
 2   Customers_DDS                     1025 non-null   float64
 3   Customers_EFT                     1025 non-null   float64
 4   T&S Collections                   1025 non-null   float64
 5   FX_Sales                          1025 non-null   float64
 6   Other_Operations                  1025 non-null   float64
 7   Total_Outflows                    1025 non-null   float64
 8   Tüpraş                            1025 non-null   float64
 9   Other_Oil                         1025 non-null   float64
```

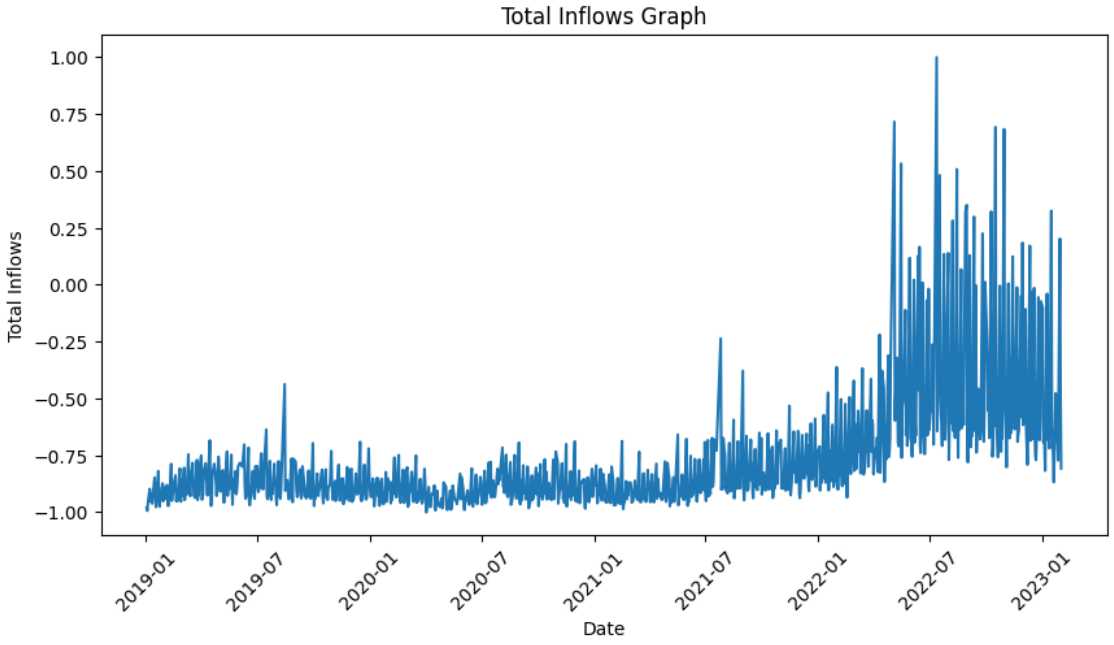
```
 10  Gas                                1025 non-null   float64
 11  Import_Payments(FX_Purchases)      1025 non-null   float64
 12  Tax                                1025 non-null   float64
 13  Operational_And_Admin._Expenses    1025 non-null   float64
 14  VIS_Buyback_Payments               1025 non-null   float64
 15  Net_Cashflow_From_Operations       1025 non-null   float64
 16  Inflows_Currency                   1025 non-null   float64
dtypes: datetime64[ns](1), float64(16)
memory usage: 144.1 KB
```

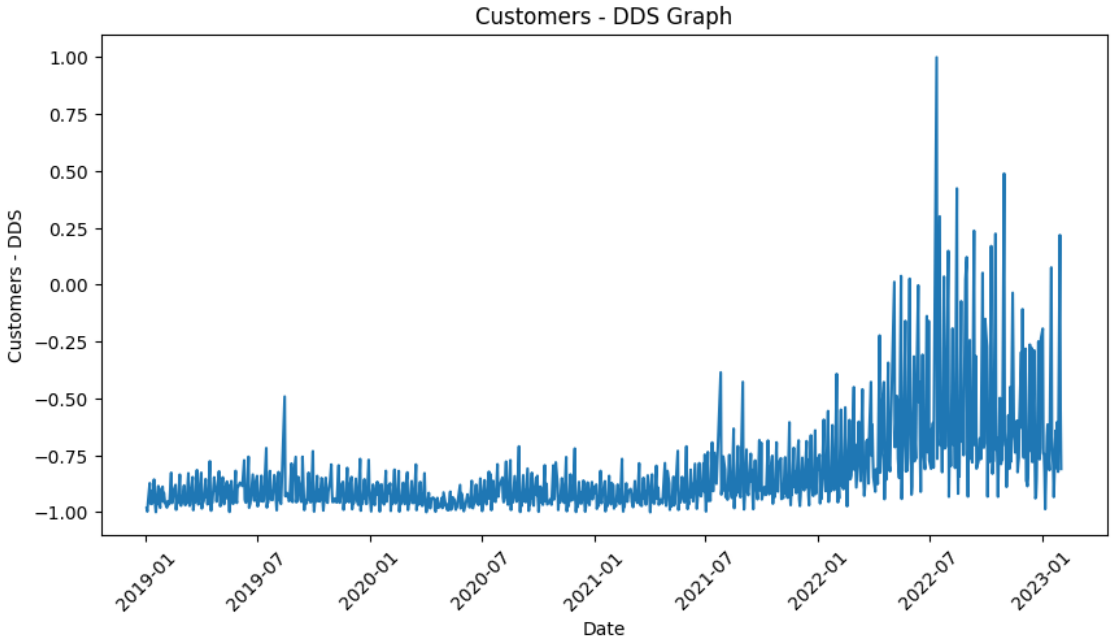
[409]:
```
scaler = MinMaxScaler(feature_range=(-1,1))
new_column1 = scaler.fit_transform(cash_flow_train["Total_Inflows"].values.
  ↪reshape(-1,1))
x = cash_flow_train["Date"]
y = new_column1
plt.figure(figsize=(10,5))
plt.plot(x, y)
plt.xlabel('Date')
plt.ylabel('Total Inflows')
plt.title('Total Inflows Graph')
plt.xticks(rotation=45)
plt.show()
new_column2 = scaler.fit_transform(cash_flow_train["Customers_DDS"].values.
  ↪reshape(-1,1))
x = cash_flow_train["Date"]
y = new_column2
plt.figure(figsize=(10,5))
plt.plot(x, y)
plt.xlabel('Date')
plt.ylabel('Customers - DDS')
plt.title('Customers - DDS Graph')
plt.xticks(rotation=45)
plt.show()
new_column3 = scaler.fit_transform(cash_flow_train["Customers_EFT"].values.
  ↪reshape(-1,1))
x = cash_flow_train["Date"]
y = new_column3
plt.figure(figsize=(10,5))
plt.plot(x, y)
plt.xlabel('Date')
plt.ylabel('Customers - EFT')
plt.title('Customers - EFT Graph')
plt.xticks(rotation=45)
plt.show()
new_column4 = scaler.fit_transform(cash_flow_train["T&S Collections"].values.
  ↪reshape(-1,1))
x = cash_flow_train["Date"]
```

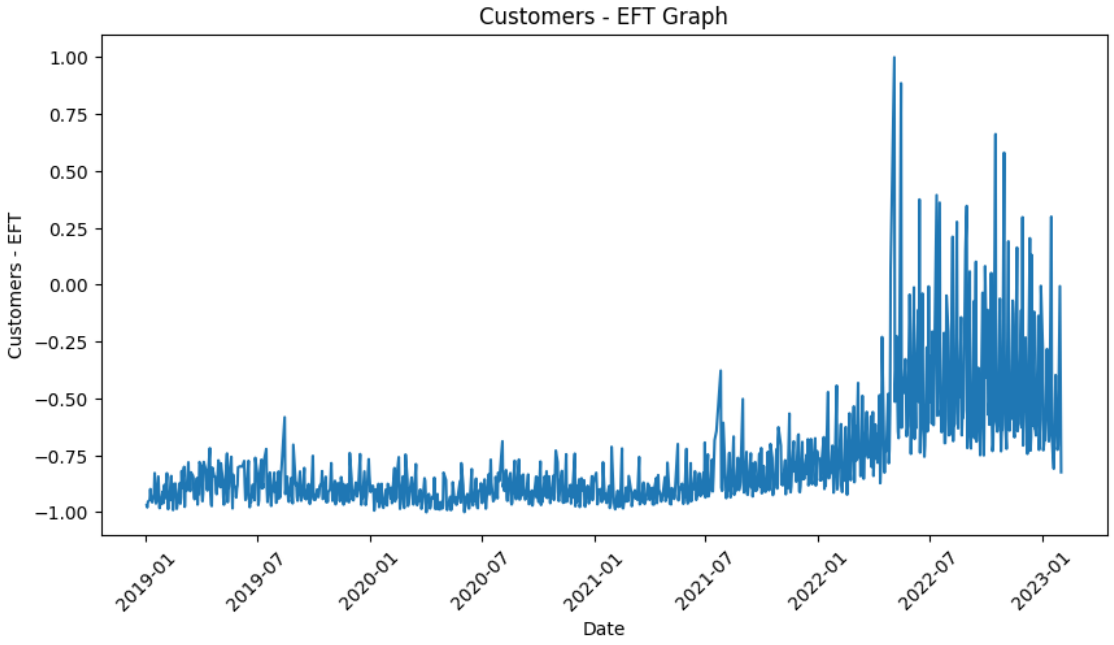
```
y = new_column4
plt.figure(figsize=(10,5))
plt.plot(x, y)
plt.xlabel('Date')
plt.ylabel('T&S Collections')
plt.title('T&S Collections Graph')
plt.xticks(rotation=45)
plt.show()
new_column5 = scaler.fit_transform(cash_flow_train["FX_Sales"].values.
 ↪reshape(-1,1))
x = cash_flow_train["Date"]
y = new_column5
plt.figure(figsize=(10,5))
plt.plot(x, y)
plt.xlabel('Date')
plt.ylabel('FX Sales')
plt.title('FX Sales Graph')
plt.xticks(rotation=45)
plt.show()
new_column6 = scaler.fit_transform(cash_flow_train["Other_Operations"].values.
 ↪reshape(-1,1))
x = cash_flow_train["Date"]
y = new_column6
plt.figure(figsize=(10,5))
plt.plot(x, y)
plt.xlabel('Date')
plt.ylabel('Other operations')
plt.title('Other operations Graph')
plt.xticks(rotation=45)
plt.show()
new_column7 = scaler.fit_transform(cash_flow_train["Total_Outflows"].values.
 ↪reshape(-1,1))
x = cash_flow_train["Date"]
y = new_column7
plt.figure(figsize=(10,5))
plt.plot(x, y)
plt.xlabel('Date')
plt.ylabel('Total Outflows')
plt.title('Total Outflows Graph')
plt.xticks(rotation=45)
plt.show()
new_column8 = scaler.fit_transform(cash_flow_train["Tüpraş"].values.
 ↪reshape(-1,1))
x = cash_flow_train["Date"]
y = new_column8
plt.figure(figsize=(10,5))
plt.plot(x, y)
```

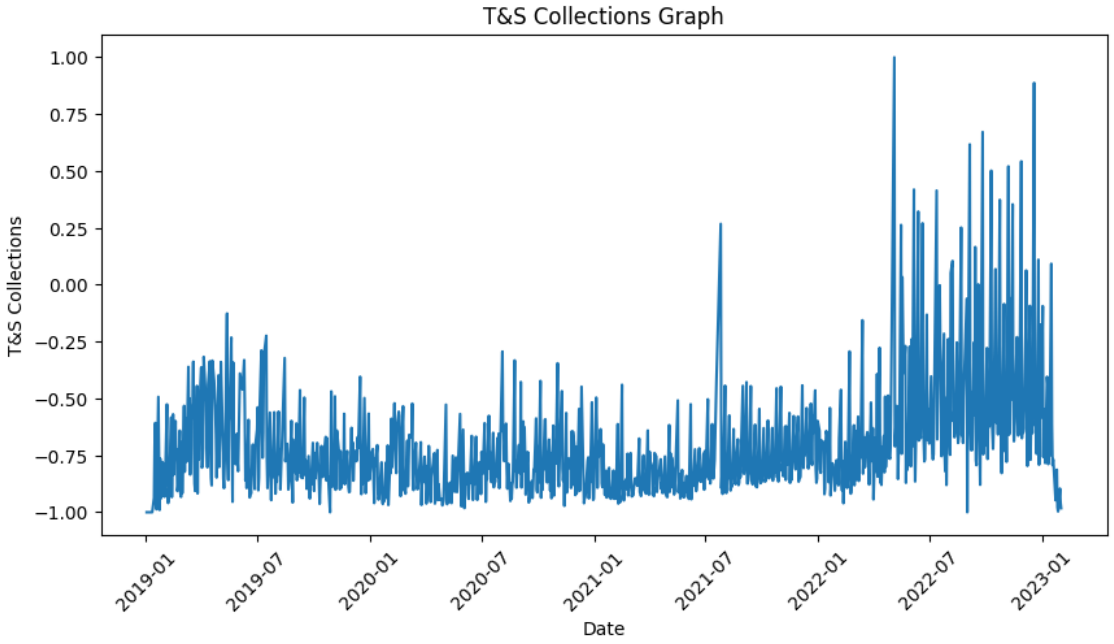
```
plt.xlabel('Date')
plt.ylabel('Tüpraş')
plt.title('Tüpraş Graph')
plt.xticks(rotation=45)
plt.show()
new_column9 = scaler.fit_transform(cash_flow_train["Other_Oil"].values.
 ↪reshape(-1,1))
x = cash_flow_train["Date"]
y = new_column9
plt.figure(figsize=(10,5))
plt.plot(x, y)
plt.xlabel('Date')
plt.ylabel('Other Oil')
plt.title('Other Oil Graph')
plt.xticks(rotation=45)
plt.show()
new_column10 = scaler.fit_transform(cash_flow_train["Gas"].values.reshape(-1,1))
x = cash_flow_train["Date"]
y = new_column10
plt.figure(figsize=(10,5))
plt.plot(x, y)
plt.xlabel('Date')
plt.ylabel('Gas')
plt.title('Gas Graph')
plt.xticks(rotation=45)
plt.show()
new_column11 = scaler.
 ↪fit_transform(cash_flow_train["Import_Payments(FX_Purchases)"].values.
 ↪reshape(-1,1))
x = cash_flow_train["Date"]
y = new_column11
plt.figure(figsize=(10,5))
plt.plot(x, y)
plt.xlabel('Date')
plt.ylabel('Import payments (FX purchases)')
plt.title('Import payments (FX purchases) Graph')
plt.xticks(rotation=45)
plt.show()
new_column12 = scaler.fit_transform(cash_flow_train["Tax"].values.reshape(-1,1))
x = cash_flow_train["Date"]
y = new_column12
plt.figure(figsize=(10,5))
plt.plot(x, y)
plt.xlabel('Date')
plt.ylabel('Tax')
plt.title('Tax Graph')
plt.xticks(rotation=45)
```

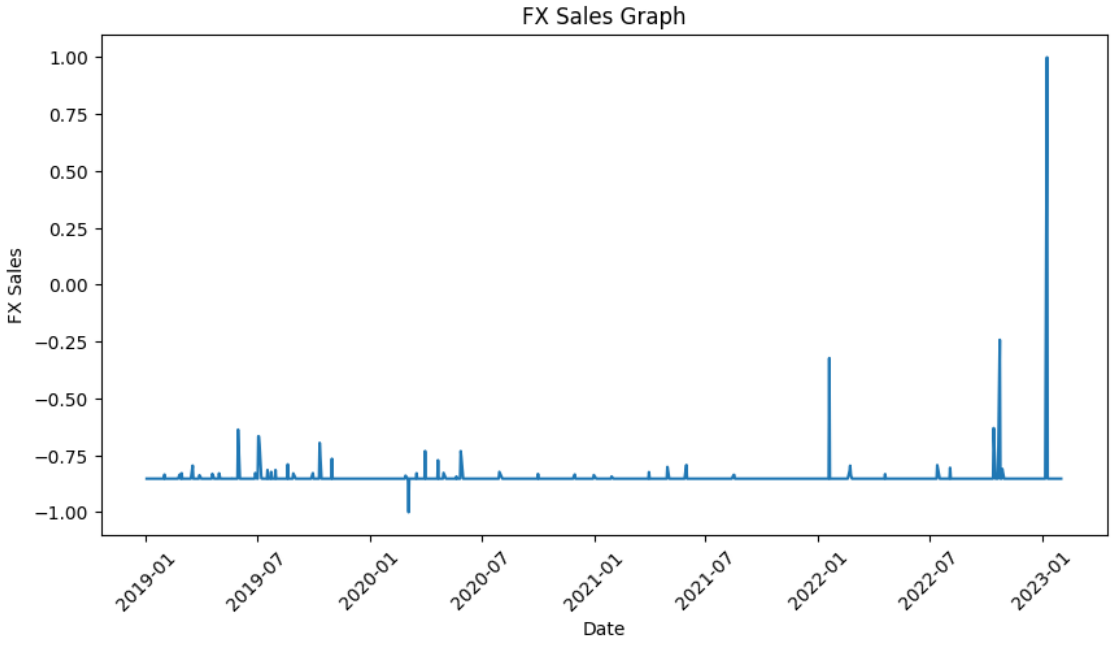
```
plt.show()
new_column13 = scaler.fit_transform(cash_flow_train["Operational_And_Admin.
  ↪_Expenses"].values.reshape(-1,1))
x = cash_flow_train["Date"]
y = new_column13
plt.figure(figsize=(10,5))
plt.plot(x, y)
plt.xlabel('Date')
plt.ylabel('Operatioınal and Admin. Expenses')
plt.title('Operatioınal and Admin. Expenses Graph')
plt.xticks(rotation=45)
plt.show()
new_column14 = scaler.fit_transform(cash_flow_train["VIS_Buyback_Payments"].
  ↪values.reshape(-1,1))
x = cash_flow_train["Date"]
y = new_column14
plt.figure(figsize=(10,5))
plt.plot(x, y)
plt.xlabel('Date')
plt.ylabel('VIS Buyback Payments')
plt.title('VIS Buyback Payments Graph')
plt.xticks(rotation=45)
plt.show()
new_column15 = scaler.
  ↪fit_transform(cash_flow_train["Net_Cashflow_From_Operations"].values.
  ↪reshape(-1,1))
cash_flow_train['Date'] = pd.to_datetime(cash_flow_train['Date'])
x = cash_flow_train["Date"]
y = new_column15
plt.figure(figsize=(10,5))
plt.plot(x, y)
plt.xlabel('Date')
plt.ylabel('Net Cashflow from Operations')
plt.title('Net Cashflow from Operations Graph')
plt.xticks(rotation=45)
plt.show()
new_column16 = scaler.fit_transform(cash_flow_train["Inflows_Currency"].values.
  ↪reshape(-1,1))
x = cash_flow_train["Date"]
y = new_column16
plt.figure(figsize=(10,5))
plt.plot(x, y)
plt.xlabel('Date')
plt.ylabel('Inflows- currency')
plt.title('Inflows- currency Graph')
plt.xticks(rotation=45)
plt.show()
```

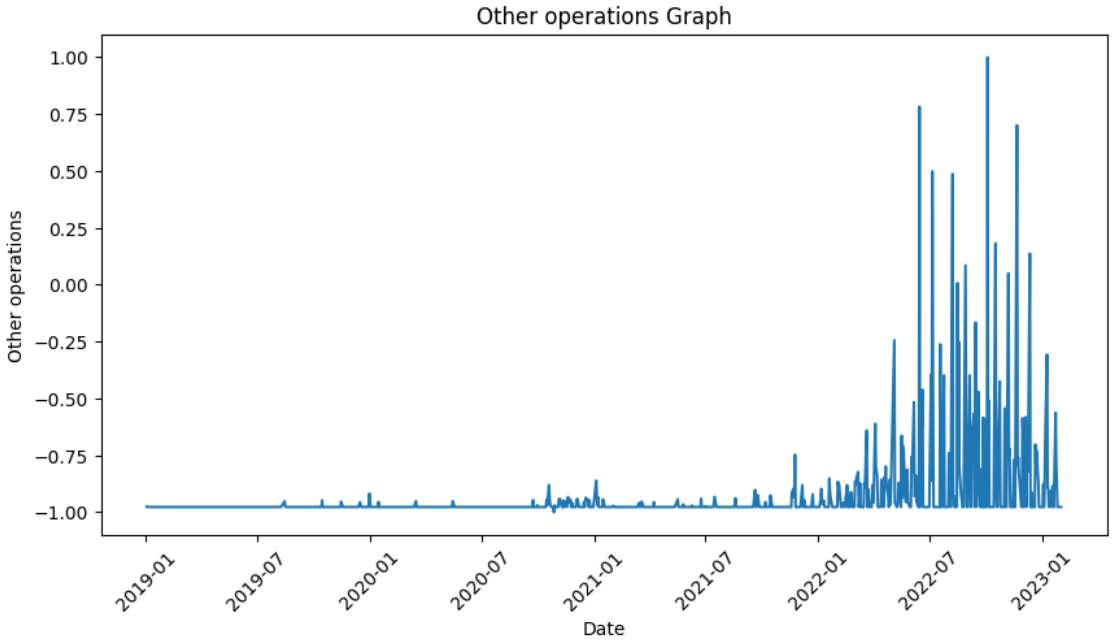

Total Inflows Graph
Total Inflows
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
2023-01
Date

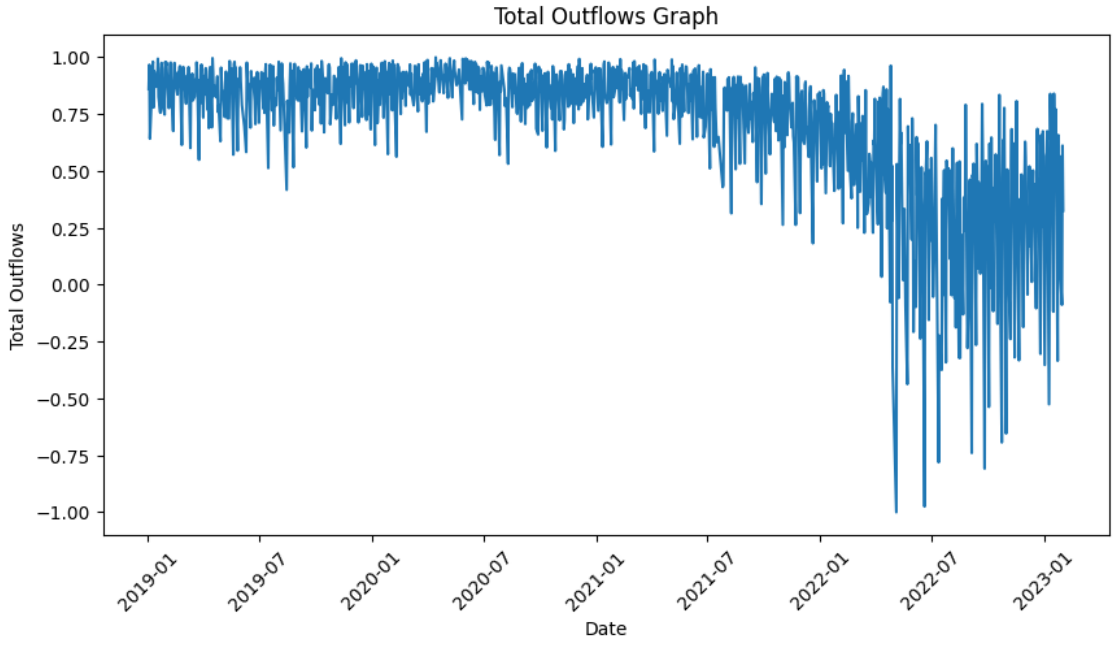

Customers - DDS Graph
Customers - DDS
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
2023-01
Date

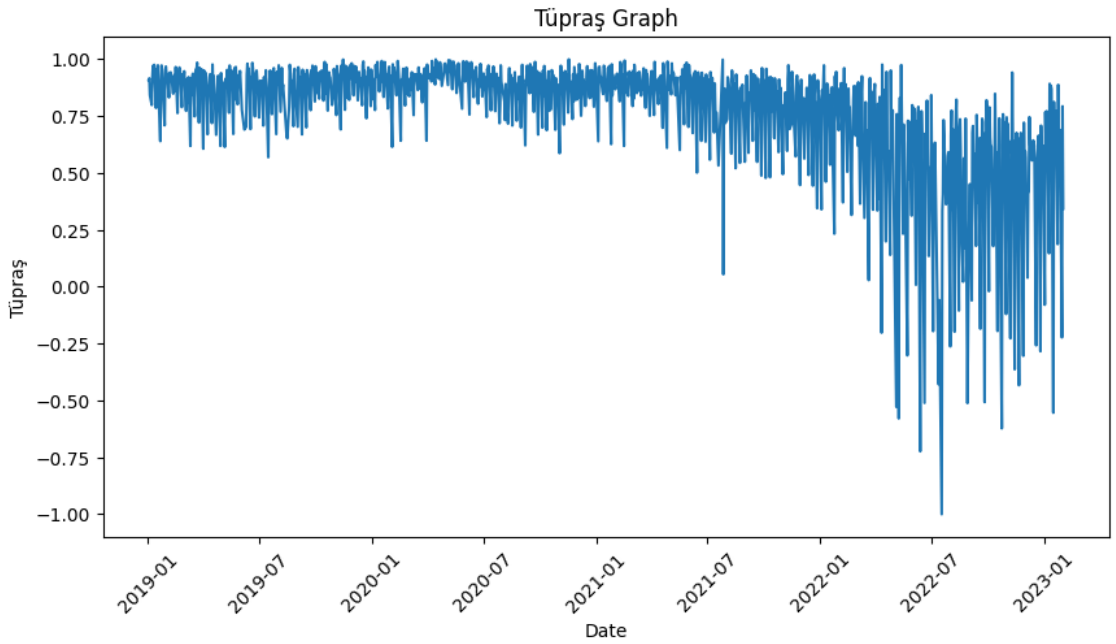

Customers - EFT Graph
Customers - EFT
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
2023-01
Date

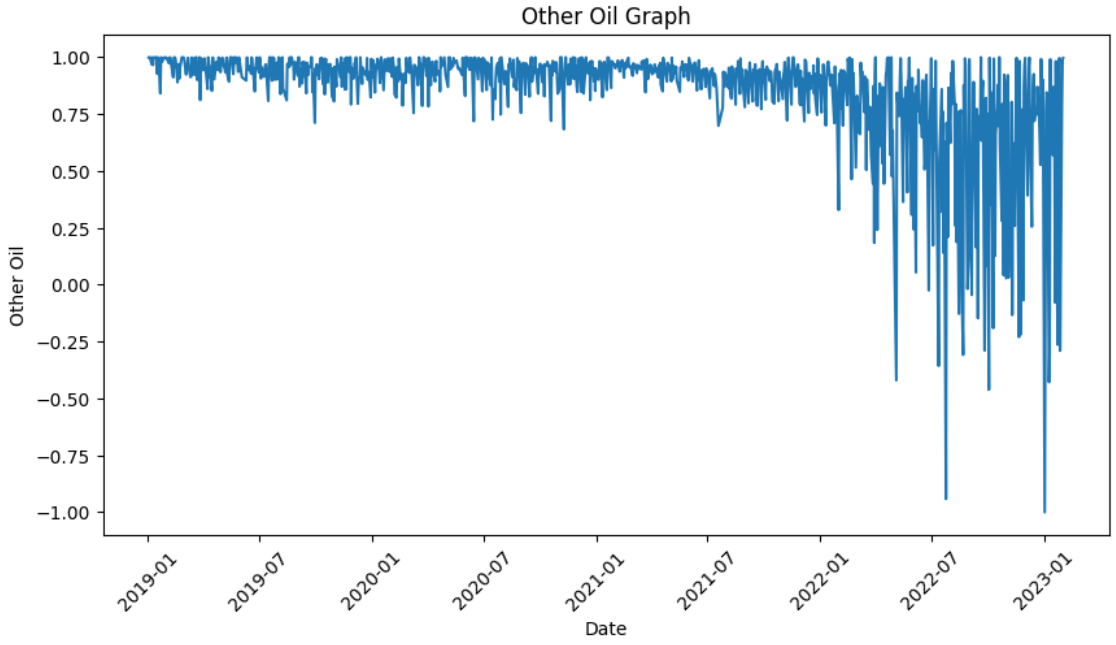

T&S Collections Graph
T&S Collections
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
2023-01
Date

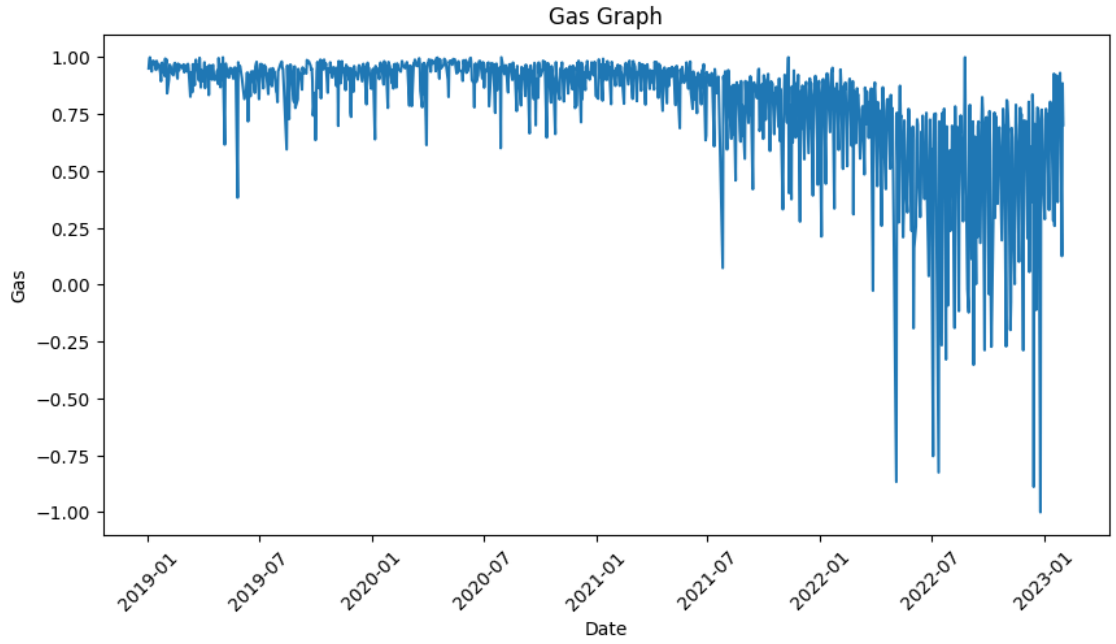

FX Sales Graph
FX Sales
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
2023-01
Date

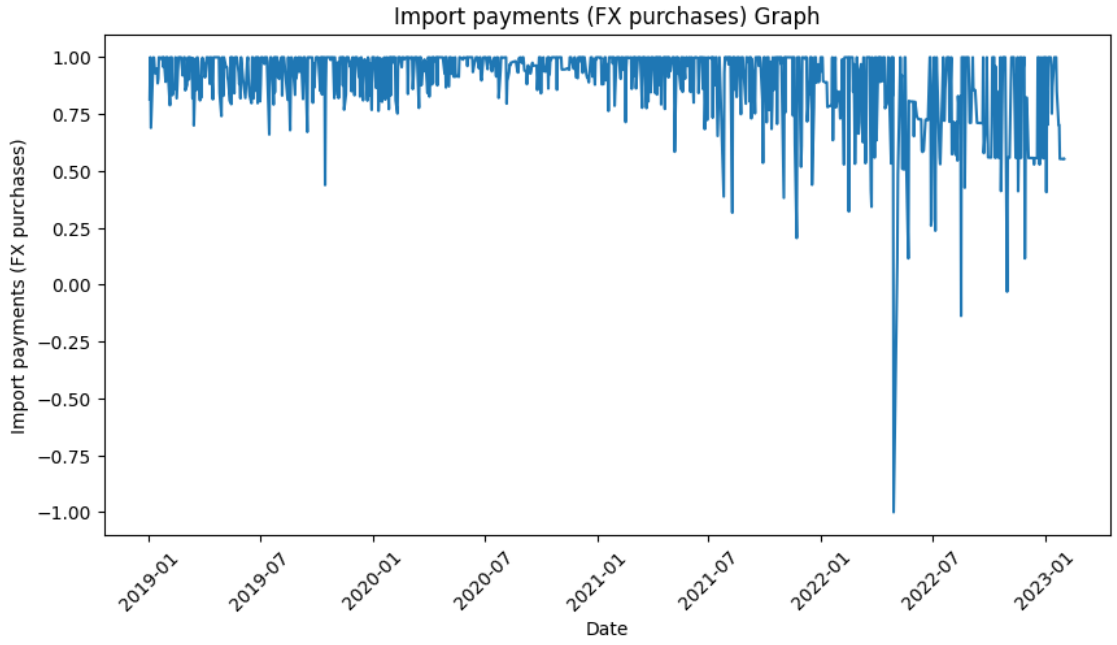

Other operations Graph
Other operations
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
2023-01
Date

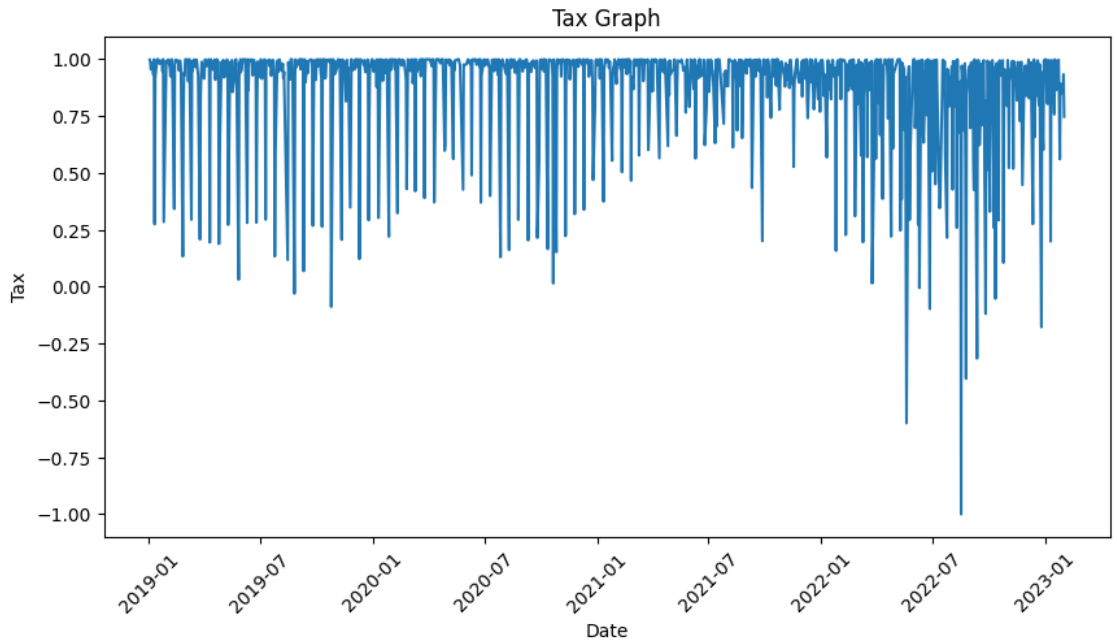

Total Outflows Graph
Total Outflows
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
2023-01
Date

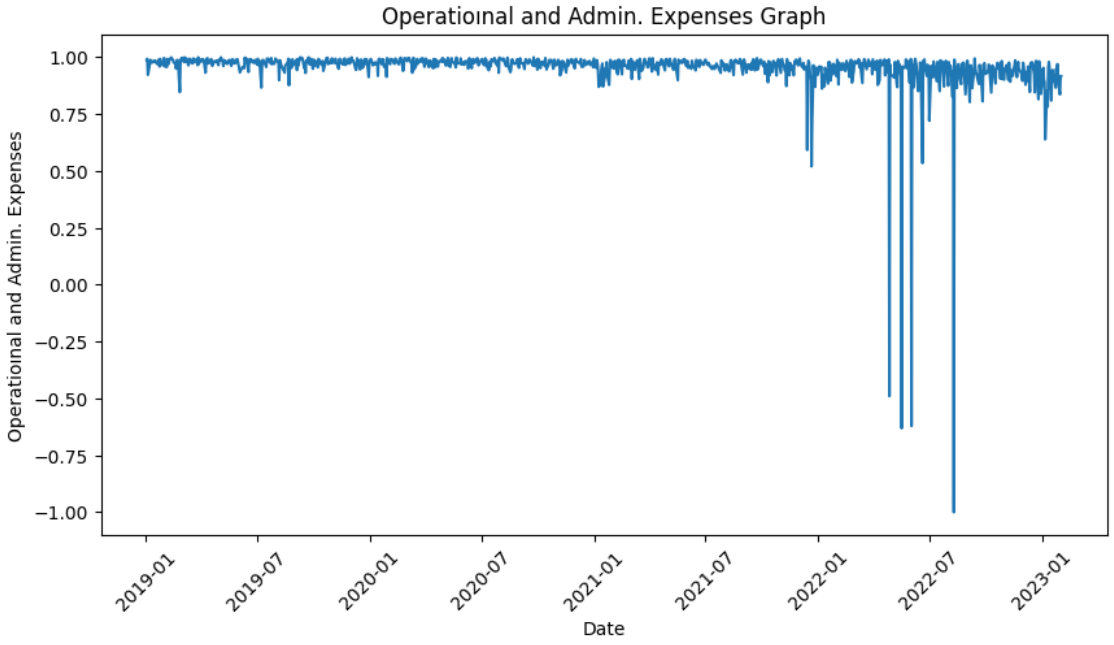

Tüpraş Graph
Tüpraş
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
2023-01
Date

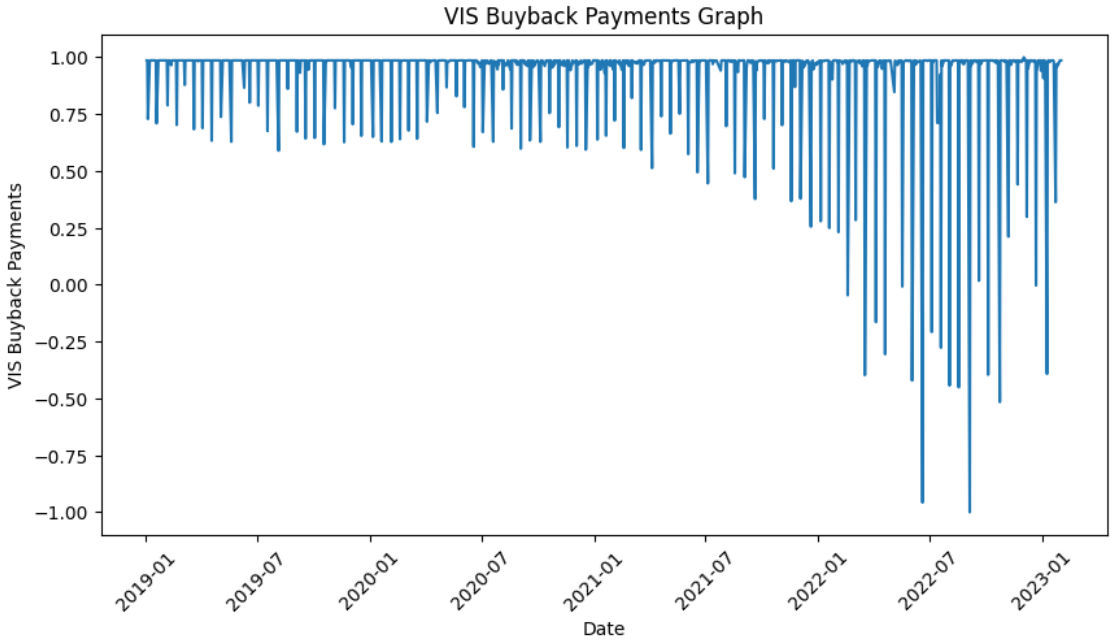

Other Oil Graph
Other Oil
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
2023-01
Date

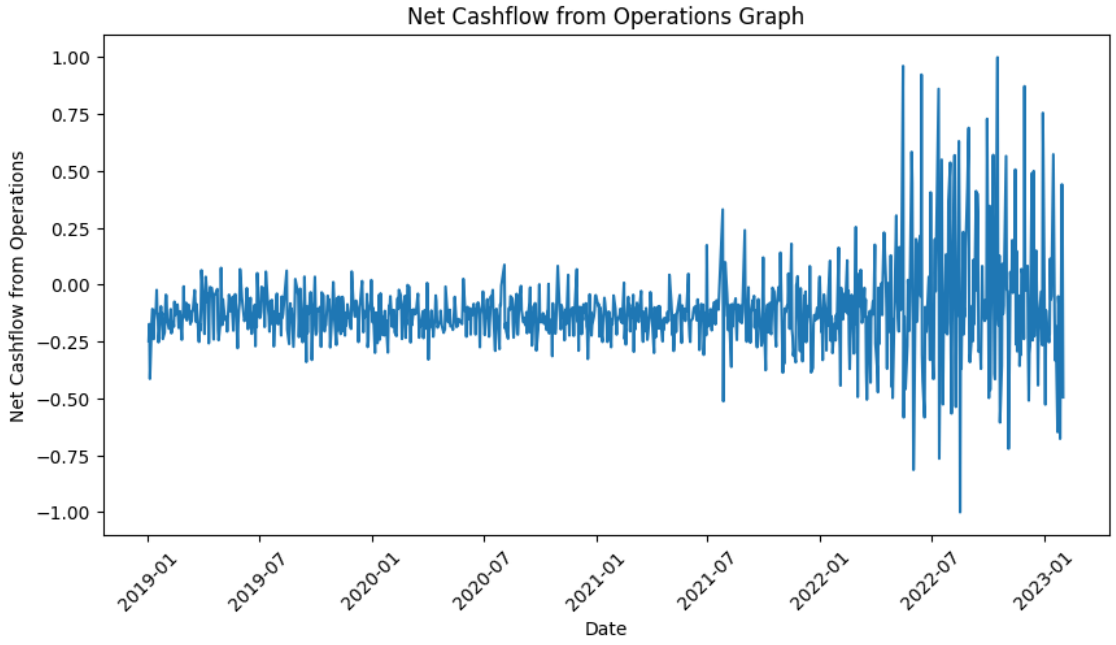

Gas Graph
Gas
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
2023-01
Date

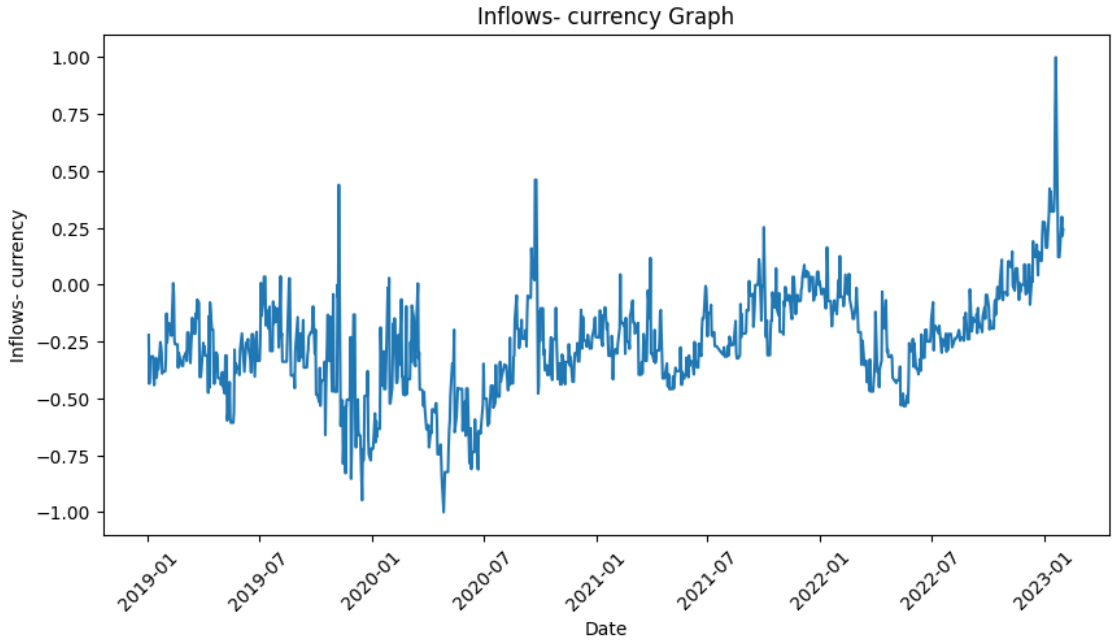

Import payments (FX purchases) Graph
Import payments (FX purchases)
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
2023-01
Date


Tax Graph
Tax
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
2023-01
Date


Operatioınal and Admin. Expenses Graph
Operatioınal and Admin. Expenses
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
2023-01
Date


VIS Buyback Payments Graph
VIS Buyback Payments
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
2023-01
Date





[410]:
```
cash_flow_train.columns
```

[410]:
```
Index(['Date', 'Total_Inflows', 'Customers_DDS', 'Customers_EFT',
       'T&S Collections', 'FX_Sales', 'Other_Operations', 'Total_Outflows',
```

```
       'Tüpraş', 'Other_Oil', 'Gas', 'Import_Payments(FX_Purchases)', 'Tax',
       'Operational_And_Admin._Expenses', 'VIS_Buyback_Payments',
       'Net_Cashflow_From_Operations', 'Inflows_Currency'],
      dtype='object')
```

[411]:
```
model = ARIMA(cash_flow_train["Total_Inflows"], order=(1, 1, 1))
model_fit = model.fit()
future_dates = pd.date_range(start='2023-02-02', end='2023-05-12')
forecast_1 = model_fit.predict(start=len(cash_flow_train),␣
 ↪end=len(cash_flow_train) + len(future_dates) - 1)
forecast_dates = pd.DataFrame({'Date': future_dates, 'Total_Inflows':␣
 ↪forecast_1})

model = ARIMA(cash_flow_train["Customers_DDS"], order=(1, 1, 1))
model_fit = model.fit()
future_dates = pd.date_range(start='2023-02-02', end='2023-05-12')
forecast_2 = model_fit.predict(start=len(cash_flow_train),␣
 ↪end=len(cash_flow_train) + len(future_dates) - 1)
forecast_dates = pd.DataFrame({'Date': future_dates, "Customers_DDS":␣
 ↪forecast_2})

model = ARIMA(cash_flow_train['Customers_EFT'], order=(1, 1, 1))
model_fit = model.fit()
future_dates = pd.date_range(start='2023-02-02', end='2023-05-12')
forecast_3 = model_fit.predict(start=len(cash_flow_train),␣
 ↪end=len(cash_flow_train) + len(future_dates) - 1)
forecast_dates = pd.DataFrame({'Date': future_dates, 'Customers_EFT':␣
 ↪forecast_3})

model = ARIMA(cash_flow_train['T&S Collections'], order=(1, 1, 1))
model_fit = model.fit()
future_dates = pd.date_range(start='2023-02-02', end='2023-05-12')
forecast_4 = model_fit.predict(start=len(cash_flow_train),␣
 ↪end=len(cash_flow_train) + len(future_dates) - 1)
forecast_dates = pd.DataFrame({'Date': future_dates, 'T&S Collections':␣
 ↪forecast_4})

model = ARIMA(cash_flow_train['FX_Sales'], order=(1, 1, 1))
model_fit = model.fit()
future_dates = pd.date_range(start='2023-02-02', end='2023-05-12')
forecast_5 = model_fit.predict(start=len(cash_flow_train),␣
 ↪end=len(cash_flow_train) + len(future_dates) - 1)
forecast_dates = pd.DataFrame({'Date': future_dates, 'FX_Sales': forecast_5})

model = ARIMA(cash_flow_train['Other_Operations'], order=(1, 1, 1))
model_fit = model.fit()
```

```
future_dates = pd.date_range(start='2023-02-02', end='2023-05-12')
forecast_6 = model_fit.predict(start=len(cash_flow_train),␣
 ↪end=len(cash_flow_train) + len(future_dates) - 1)
forecast_dates = pd.DataFrame({'Date': future_dates, 'Other_Operations':␣
 ↪forecast_6})

model = ARIMA(cash_flow_train['Total_Outflows'], order=(1, 1, 1))
model_fit = model.fit()
future_dates = pd.date_range(start='2023-02-02', end='2023-05-12')
forecast_7 = model_fit.predict(start=len(cash_flow_train),␣
 ↪end=len(cash_flow_train) + len(future_dates) - 1)
forecast_dates = pd.DataFrame({'Date': future_dates, 'Total_Outflows':␣
 ↪forecast_7})

model = ARIMA(cash_flow_train['Tüpraş'], order=(1, 1, 1))
model_fit = model.fit()
future_dates = pd.date_range(start='2023-02-02', end='2023-05-12')
forecast_8 = model_fit.predict(start=len(cash_flow_train),␣
 ↪end=len(cash_flow_train) + len(future_dates) - 1)
forecast_dates = pd.DataFrame({'Date': future_dates, 'Tüpraş': forecast_8})

model = ARIMA(cash_flow_train["Other_Oil"], order=(1, 1, 1))
model_fit = model.fit()
future_dates = pd.date_range(start='2023-02-02', end='2023-05-12')
forecast_9 = model_fit.predict(start=len(cash_flow_train),␣
 ↪end=len(cash_flow_train) + len(future_dates) - 1)
forecast_dates = pd.DataFrame({'Date': future_dates, "Other_Oil": forecast_9})

model = ARIMA(cash_flow_train['Gas'], order=(1, 1, 1))
model_fit = model.fit()
future_dates = pd.date_range(start='2023-02-02', end='2023-05-12')
forecast_10 = model_fit.predict(start=len(cash_flow_train),␣
 ↪end=len(cash_flow_train) + len(future_dates) - 1)
forecast_dates = pd.DataFrame({'Date': future_dates, 'Gas': forecast_10})

model = ARIMA(cash_flow_train["Import_Payments(FX_Purchases)"], order=(1, 1, 1))
model_fit = model.fit()
future_dates = pd.date_range(start='2023-02-02', end='2023-05-12')
forecast_11 = model_fit.predict(start=len(cash_flow_train),␣
 ↪end=len(cash_flow_train) + len(future_dates) - 1)
forecast_dates = pd.DataFrame({'Date': future_dates,␣
 ↪"Import_Payments(FX_Purchases)": forecast_11})

model = ARIMA(cash_flow_train["Tax"], order=(1, 1, 1))
model_fit = model.fit()
future_dates = pd.date_range(start='2023-02-02', end='2023-05-12')
```

```
forecast_12 = model_fit.predict(start=len(cash_flow_train),␣
 ↪end=len(cash_flow_train) + len(future_dates) - 1)
forecast_dates = pd.DataFrame({'Date': future_dates, "Tax": forecast_12})

model = ARIMA(cash_flow_train["Operational_And_Admin._Expenses"], order=(1, 1,␣
 ↪1))
model_fit = model.fit()
future_dates = pd.date_range(start='2023-02-02', end='2023-05-12')
forecast_13 = model_fit.predict(start=len(cash_flow_train),␣
 ↪end=len(cash_flow_train) + len(future_dates) - 1)
forecast_dates = pd.DataFrame({'Date': future_dates, "Operational_And_Admin.
 ↪_Expenses": forecast_13})

model = ARIMA(cash_flow_train['VIS_Buyback_Payments'], order=(1, 1, 1))
model_fit = model.fit()
future_dates = pd.date_range(start='2023-02-02', end='2023-05-12')
forecast_14 = model_fit.predict(start=len(cash_flow_train),␣
 ↪end=len(cash_flow_train) + len(future_dates) - 1)
forecast_dates = pd.DataFrame({'Date': future_dates, 'VIS_Buyback_Payments':␣
 ↪forecast_14})

model = ARIMA(cash_flow_train['Inflows_Currency'], order=(1, 1, 1))
model_fit = model.fit()
future_dates = pd.date_range(start='2023-02-02', end='2023-05-12')
forecast_15 = model_fit.predict(start=len(cash_flow_train),␣
 ↪end=len(cash_flow_train) + len(future_dates) - 1)
forecast_dates = pd.DataFrame({'Date': future_dates, 'Inflows_Currency':␣
 ↪forecast_15})

forecast_dates['Total_Inflows'] = forecast_1
forecast_dates['Customers_DDS'] = forecast_2
forecast_dates['Customers_EFT'] = forecast_3
forecast_dates['T&S Collections'] = forecast_4
forecast_dates['FX_Sales'] = forecast_5
forecast_dates['Other_Operations'] = forecast_6
forecast_dates['Total_Outflows'] = forecast_7
forecast_dates['Tüpraş'] = forecast_8
forecast_dates['Other_Oil'] = forecast_9
forecast_dates['Gas'] = forecast_10
forecast_dates['Import_Payments(FX_Purchases)'] = forecast_11
forecast_dates['Tax'] = forecast_12
forecast_dates['Operational_And_Admin._Expenses'] = forecast_13
forecast_dates['VIS_Buyback_Payments'] = forecast_14
forecast_dates['Inflows_Currency'] = forecast_15

forecast_dates.head()
```

[411]:
```
            Date  Inflows_Currency  Total_Inflows  Customers_DDS  \
1025 2023-02-02     219290.974865   2.300734e+08   1.152604e+08
1026 2023-02-03     221948.765524   2.107674e+08   1.073756e+08
1027 2023-02-04     223099.209275   2.134508e+08   1.084414e+08
1028 2023-02-05     223597.187105   2.130779e+08   1.082973e+08
1029 2023-02-06     223812.740380   2.131297e+08   1.083168e+08

      Customers_EFT  T&S Collections      FX_Sales  Other_Operations  \
1025   8.468234e+07     1.291307e+07  1.291690e+06      6.908793e+06
1026   8.211365e+07     1.192515e+07  1.298122e+06      6.549110e+06
1027   8.224267e+07     1.200509e+07  1.298154e+06      6.567836e+06
1028   8.223619e+07     1.199862e+07  1.298155e+06      6.566861e+06
1029   8.223651e+07     1.199914e+07  1.298155e+06      6.566912e+06

      Total_Outflows        Tüpraş     Other_Oil           Gas  \
1025   -1.912566e+08 -6.894411e+07 -4.762557e+07 -8.954231e+06
1026   -1.927760e+08 -7.368720e+07 -4.303180e+07 -8.652969e+06
1027   -1.925621e+08 -7.296129e+07 -4.347785e+07 -8.694285e+06
1028   -1.925923e+08 -7.307239e+07 -4.343454e+07 -8.688619e+06
1029   -1.925880e+08 -7.305539e+07 -4.343874e+07 -8.689396e+06

      Import_Payments(FX_Purchases)           Tax  \
1025                  -4.346847e+07 -1.172992e+07
1026                  -4.065481e+07 -1.209665e+07
1027                  -4.036326e+07 -1.206978e+07
1028                  -4.033305e+07 -1.207175e+07
1029                  -4.032992e+07 -1.207160e+07

      Operational_And_Admin._Expenses  VIS_Buyback_Payments
1025                    -7.998464e+06         -1.101911e+07
1026                    -7.987990e+06         -1.003164e+07
1027                    -7.988341e+06         -1.012013e+07
1028                    -7.988329e+06         -1.011220e+07
1029                    -7.988329e+06         -1.011291e+07
```

[412]:
```
forecast_dates.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 100 entries, 1025 to 1124
Data columns (total 16 columns):
 #   Column                          Non-Null Count  Dtype
---  ------                          --------------  -----
 0   Date                            100 non-null    datetime64[ns]
 1   Inflows_Currency                100 non-null    float64
 2   Total_Inflows                   100 non-null    float64
 3   Customers_DDS                   100 non-null    float64
 4   Customers_EFT                   100 non-null    float64
```

```
 5   T&S Collections                  100 non-null    float64
 6   FX_Sales                         100 non-null    float64
 7   Other_Operations                 100 non-null    float64
 8   Total_Outflows                   100 non-null    float64
 9   Tüpraş                           100 non-null    float64
 10  Other_Oil                        100 non-null    float64
 11  Gas                              100 non-null    float64
 12  Import_Payments(FX_Purchases)    100 non-null    float64
 13  Tax                              100 non-null    float64
 14  Operational_And_Admin._Expenses  100 non-null    float64
 15  VIS_Buyback_Payments             100 non-null    float64
dtypes: datetime64[ns](1), float64(15)
memory usage: 13.3 KB
```

[413]:
```
forecast_dates['Net_Cashflow_From_Operations'] = np.nan
forecast_dates.head()
```

[413]:

	Date	Inflows_Currency	Total_Inflows	Customers_DDS	Customers_EFT	T&S Collections	FX_Sales	Other_Operations	Total_Outflows	Tüpraş	Other_Oil	Gas	Import_Payments(FX_Purchases)	Tax	Operational_And_Admin._Expenses	VIS_Buyback_Payments
1025	2023-02-02	219290.974865	2.300734e+08	1.152604e+08	8.468234e+07	1.291307e+07	1.291690e+06	6.908793e+06	-1.912566e+08	-6.894411e+07	-4.762557e+07	-8.954231e+06	-4.346847e+07	-1.172992e+07	-7.998464e+06	-1.101911e+07
1026	2023-02-03	221948.765524	2.107674e+08	1.073756e+08	8.211365e+07	1.192515e+07	1.298122e+06	6.549110e+06	-1.927760e+08	-7.368720e+07	-4.303180e+07	-8.652969e+06	-4.065481e+07	-1.209665e+07		
1027	2023-02-04	223099.209275	2.134508e+08	1.084414e+08	8.224267e+07	1.200509e+07	1.298154e+06	6.567836e+06	-1.925621e+08	-7.296129e+07	-4.347785e+07	-8.694285e+06	-4.036326e+07	-1.206978e+07		
1028	2023-02-05	223597.187105	2.130779e+08	1.082973e+08	8.223619e+07	1.199862e+07	1.298155e+06	6.566861e+06	-1.925923e+08	-7.307239e+07	-4.343454e+07	-8.688619e+06	-4.033305e+07	-1.207175e+07		
1029	2023-02-06	223812.740380	2.131297e+08	1.083168e+08	8.223651e+07	1.199914e+07	1.298155e+06	6.566912e+06	-1.925880e+08	-7.305539e+07	-4.343874e+07	-8.689396e+06	-4.032992e+07	-1.207160e+07		

```
1026                    -7.987990e+06         -1.003164e+07
1027                    -7.988341e+06         -1.012013e+07
1028                    -7.988329e+06         -1.011220e+07
1029                    -7.988329e+06         -1.011291e+07

      Net_Cashflow_From_Operations
1025                           NaN
1026                           NaN
1027                           NaN
1028                           NaN
1029                           NaN
```

[414]:
```
forecast_dates.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 100 entries, 1025 to 1124
Data columns (total 17 columns):
 #   Column                           Non-Null Count  Dtype
---  ------                           --------------  -----
 0   Date                             100 non-null    datetime64[ns]
 1   Inflows_Currency                 100 non-null    float64
 2   Total_Inflows                    100 non-null    float64
 3   Customers_DDS                    100 non-null    float64
 4   Customers_EFT                    100 non-null    float64
 5   T&S Collections                  100 non-null    float64
 6   FX_Sales                         100 non-null    float64
 7   Other_Operations                 100 non-null    float64
 8   Total_Outflows                   100 non-null    float64
 9   Tüpraş                           100 non-null    float64
 10  Other_Oil                        100 non-null    float64
 11  Gas                              100 non-null    float64
 12  Import_Payments(FX_Purchases)    100 non-null    float64
 13  Tax                              100 non-null    float64
 14  Operational_And_Admin._Expenses  100 non-null    float64
 15  VIS_Buyback_Payments             100 non-null    float64
 16  Net_Cashflow_From_Operations     0 non-null      float64
dtypes: datetime64[ns](1), float64(16)
memory usage: 14.1 KB
```

[415]:
```
cash_flow_train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1025 entries, 0 to 1024
Data columns (total 17 columns):
 #   Column                           Non-Null Count  Dtype
---  ------                           --------------  -----
 0   Date                             1025 non-null   datetime64[ns]
 1   Total_Inflows                    1025 non-null   float64
```

```
 2   Customers_DDS                    1025 non-null   float64
 3   Customers_EFT                    1025 non-null   float64
 4   T&S Collections                  1025 non-null   float64
 5   FX_Sales                         1025 non-null   float64
 6   Other_Operations                 1025 non-null   float64
 7   Total_Outflows                   1025 non-null   float64
 8   Tüpraş                           1025 non-null   float64
 9   Other_Oil                        1025 non-null   float64
 10  Gas                              1025 non-null   float64
 11  Import_Payments(FX_Purchases)    1025 non-null   float64
 12  Tax                              1025 non-null   float64
 13  Operational_And_Admin._Expenses  1025 non-null   float64
 14  VIS_Buyback_Payments             1025 non-null   float64
 15  Net_Cashflow_From_Operations     1025 non-null   float64
 16  Inflows_Currency                 1025 non-null   float64
dtypes: datetime64[ns](1), float64(16)
memory usage: 144.1 KB
```

[416]:
```
merged_data = pd.concat([cash_flow_train.set_index('Date'), forecast_dates.
  ↪set_index('Date')], axis=0)
merged_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 1125 entries, 2019-01-02 to 2023-05-12
Data columns (total 16 columns):
 #   Column                           Non-Null Count  Dtype
---  ------                           --------------  -----
 0   Total_Inflows                    1125 non-null   float64
 1   Customers_DDS                    1125 non-null   float64
 2   Customers_EFT                    1125 non-null   float64
 3   T&S Collections                  1125 non-null   float64
 4   FX_Sales                         1125 non-null   float64
 5   Other_Operations                 1125 non-null   float64
 6   Total_Outflows                   1125 non-null   float64
 7   Tüpraş                           1125 non-null   float64
 8   Other_Oil                        1125 non-null   float64
 9   Gas                              1125 non-null   float64
 10  Import_Payments(FX_Purchases)    1125 non-null   float64
 11  Tax                              1125 non-null   float64
 12  Operational_And_Admin._Expenses  1125 non-null   float64
 13  VIS_Buyback_Payments             1125 non-null   float64
 14  Net_Cashflow_From_Operations     1025 non-null   float64
 15  Inflows_Currency                 1125 non-null   float64
dtypes: float64(16)
memory usage: 149.4 KB
```

[417]:
```
merged_data_11 = merged_data.dropna()
merged_data_11.info()
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 1025 entries, 2019-01-02 to 2023-02-01
Data columns (total 16 columns):
 #   Column                           Non-Null Count  Dtype
---  ------                           --------------  -----
 0   Total_Inflows                    1025 non-null   float64
 1   Customers_DDS                    1025 non-null   float64
 2   Customers_EFT                    1025 non-null   float64
 3   T&S Collections                  1025 non-null   float64
 4   FX_Sales                         1025 non-null   float64
 5   Other_Operations                 1025 non-null   float64
 6   Total_Outflows                   1025 non-null   float64
 7   Tüpraş                           1025 non-null   float64
 8   Other_Oil                        1025 non-null   float64
 9   Gas                              1025 non-null   float64
 10  Import_Payments(FX_Purchases)    1025 non-null   float64
 11  Tax                              1025 non-null   float64
 12  Operational_And_Admin._Expenses  1025 non-null   float64
 13  VIS_Buyback_Payments             1025 non-null   float64
 14  Net_Cashflow_From_Operations     1025 non-null   float64
 15  Inflows_Currency                 1025 non-null   float64
dtypes: float64(16)
memory usage: 136.1 KB
```

[418]:
```
cash_flow_train.columns
```

[418]:
```
Index(['Date', 'Total_Inflows', 'Customers_DDS', 'Customers_EFT',
       'T&S Collections', 'FX_Sales', 'Other_Operations', 'Total_Outflows',
       'Tüpraş', 'Other_Oil', 'Gas', 'Import_Payments(FX_Purchases)', 'Tax',
       'Operational_And_Admin._Expenses', 'VIS_Buyback_Payments',
       'Net_Cashflow_From_Operations', 'Inflows_Currency'],
      dtype='object')
```

[419]:
```
X = merged_data_11[['Total_Inflows', 'Customers_DDS', 'Customers_EFT',
       'T&S Collections', 'FX_Sales', 'Other_Operations', 'Total_Outflows',
       'Tüpraş', 'Other_Oil', 'Gas', 'Import_Payments(FX_Purchases)', 'Tax',
       'Operational_And_Admin._Expenses', 'VIS_Buyback_Payments',
       'Inflows_Currency']]
y = merged_data_11["Net_Cashflow_From_Operations"].dropna()
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
model = LinearRegression()
model.fit(X_train, y_train)
empty_lines = merged_data[merged_data["Net_Cashflow_From_Operations"].isnull()]
```

```
if not empty_lines.empty:
    X_empty = empty_lines[['Total_Inflows', 'Customers_DDS', 'Customers_EFT',
       'T&S Collections', 'FX_Sales', 'Other_Operations', 'Total_Outflows',
       'Tüpraş', 'Other_Oil', 'Gas', 'Import_Payments(FX_Purchases)', 'Tax',
       'Operational_And_Admin._Expenses', 'VIS_Buyback_Payments',
       'Inflows_Currency']]
    prediction_LinearRegression = model.predict(X_empty)

X = merged_data_11[['Total_Inflows', 'Customers_DDS', 'Customers_EFT',
       'T&S Collections', 'FX_Sales', 'Other_Operations', 'Total_Outflows',
       'Tüpraş', 'Other_Oil', 'Gas', 'Import_Payments(FX_Purchases)', 'Tax',
       'Operational_And_Admin._Expenses', 'VIS_Buyback_Payments',
       'Inflows_Currency']]
y = merged_data_11["Net_Cashflow_From_Operations"].dropna()
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
model = DecisionTreeRegressor()
model.fit(X_train, y_train)
empty_lines = merged_data[merged_data["Net_Cashflow_From_Operations"].isnull()]
if not empty_lines.empty:
    X_empty = empty_lines[['Total_Inflows', 'Customers_DDS', 'Customers_EFT',
       'T&S Collections', 'FX_Sales', 'Other_Operations', 'Total_Outflows',
       'Tüpraş', 'Other_Oil', 'Gas', 'Import_Payments(FX_Purchases)', 'Tax',
       'Operational_And_Admin._Expenses', 'VIS_Buyback_Payments',
       'Inflows_Currency']]
    prediction_DecisionTreeRegressor = model.predict(X_empty)

X = merged_data_11[['Total_Inflows', 'Customers_DDS', 'Customers_EFT',
       'T&S Collections', 'FX_Sales', 'Other_Operations', 'Total_Outflows',
       'Tüpraş', 'Other_Oil', 'Gas', 'Import_Payments(FX_Purchases)', 'Tax',
       'Operational_And_Admin._Expenses', 'VIS_Buyback_Payments',
       'Inflows_Currency']]
y = merged_data_11["Net_Cashflow_From_Operations"].dropna()
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
model = RandomForestRegressor()
model.fit(X_train, y_train)
empty_lines = merged_data[merged_data["Net_Cashflow_From_Operations"].isnull()]
if not empty_lines.empty:
    X_empty = empty_lines[['Total_Inflows', 'Customers_DDS', 'Customers_EFT',
       'T&S Collections', 'FX_Sales', 'Other_Operations', 'Total_Outflows',
       'Tüpraş', 'Other_Oil', 'Gas', 'Import_Payments(FX_Purchases)', 'Tax',
       'Operational_And_Admin._Expenses', 'VIS_Buyback_Payments',
       'Inflows_Currency']]
    prediction_RandomForestRegressor = model.predict(X_empty)

X = merged_data_11[['Total_Inflows', 'Customers_DDS', 'Customers_EFT',
```

```
       'T&S Collections', 'FX_Sales', 'Other_Operations', 'Total_Outflows',
       'Tüpraş', 'Other_Oil', 'Gas', 'Import_Payments(FX_Purchases)', 'Tax',
       'Operational_And_Admin._Expenses', 'VIS_Buyback_Payments',
       'Inflows_Currency']]
y = merged_data_11["Net_Cashflow_From_Operations"].dropna()
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
model = SVR()
model.fit(X_train, y_train)
empty_lines = merged_data[merged_data["Net_Cashflow_From_Operations"].isnull()]
if not empty_lines.empty:
    X_empty = empty_lines[['Total_Inflows', 'Customers_DDS', 'Customers_EFT',
       'T&S Collections', 'FX_Sales', 'Other_Operations', 'Total_Outflows',
       'Tüpraş', 'Other_Oil', 'Gas', 'Import_Payments(FX_Purchases)', 'Tax',
       'Operational_And_Admin._Expenses', 'VIS_Buyback_Payments',
       'Inflows_Currency']]
    prediction_SVR = model.predict(X_empty)

X = merged_data_11[['Total_Inflows', 'Customers_DDS', 'Customers_EFT',
       'T&S Collections', 'FX_Sales', 'Other_Operations', 'Total_Outflows',
       'Tüpraş', 'Other_Oil', 'Gas', 'Import_Payments(FX_Purchases)', 'Tax',
       'Operational_And_Admin._Expenses', 'VIS_Buyback_Payments',
       'Inflows_Currency']]
y = merged_data_11["Net_Cashflow_From_Operations"].dropna()
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
model = GradientBoostingRegressor()
model.fit(X_train, y_train)
empty_lines = merged_data[merged_data["Net_Cashflow_From_Operations"].isnull()]
if not empty_lines.empty:
    X_empty = empty_lines[['Total_Inflows', 'Customers_DDS', 'Customers_EFT',
       'T&S Collections', 'FX_Sales', 'Other_Operations', 'Total_Outflows',
       'Tüpraş', 'Other_Oil', 'Gas', 'Import_Payments(FX_Purchases)', 'Tax',
       'Operational_And_Admin._Expenses', 'VIS_Buyback_Payments',
       'Inflows_Currency']]
    prediction_GradientBoostingRegressor = model.predict(X_empty)

X = merged_data_11[['Total_Inflows', 'Customers_DDS', 'Customers_EFT',
       'T&S Collections', 'FX_Sales', 'Other_Operations', 'Total_Outflows',
       'Tüpraş', 'Other_Oil', 'Gas', 'Import_Payments(FX_Purchases)', 'Tax',
       'Operational_And_Admin._Expenses', 'VIS_Buyback_Payments',
       'Inflows_Currency']]
y = merged_data_11["Net_Cashflow_From_Operations"].dropna()
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
model = KNeighborsRegressor()
model.fit(X_train, y_train)
```

```
empty_lines = merged_data[merged_data["Net_Cashflow_From_Operations"].isnull()]
if not empty_lines.empty:
    X_empty = empty_lines[['Total_Inflows', 'Customers_DDS', 'Customers_EFT',
       'T&S Collections', 'FX_Sales', 'Other_Operations', 'Total_Outflows',
       'Tüpraş', 'Other_Oil', 'Gas', 'Import_Payments(FX_Purchases)', 'Tax',
       'Operational_And_Admin._Expenses', 'VIS_Buyback_Payments',
       'Inflows_Currency']]
    prediction_KNeighborsRegressor = model.predict(X_empty)
```

[420]:
```
X = merged_data_11[['Total_Inflows', 'Customers_DDS', 'Customers_EFT',
       'T&S Collections', 'FX_Sales', 'Other_Operations', 'Total_Outflows',
       'Tüpraş', 'Other_Oil', 'Gas', 'Import_Payments(FX_Purchases)', 'Tax',
       'Operational_And_Admin._Expenses', 'VIS_Buyback_Payments',
       'Inflows_Currency']]
y = merged_data_11["Net_Cashflow_From_Operations"].dropna()

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)

models = [LinearRegression(), DecisionTreeRegressor(), RandomForestRegressor(),␣
 ↪SVR(), GradientBoostingRegressor(), KNeighborsRegressor()]
predicts = []

for model in models:
    model.fit(X_train, y_train)
    prediction = model.predict(X_test)
    predicts.append(prediction)
```

[421]:
```
metrics = ["mean_absolute_error", "mean_squared_error",␣
 ↪"root_mean_squared_error", "r2_score"]
algorithm_names = ["LinearRegression", "DecisionTreeRegressor",␣
 ↪"RandomForestRegressor", "SVR", "GradientBoostingRegressor",␣
 ↪"KNeighborsRegressor"]
series = []

def performance_calculate(y_true, y_pred):
    mae = mean_absolute_error(y_true, y_pred)
    mse = mean_squared_error(y_true, y_pred)
    rmse = np.sqrt(mse)
    r2 = r2_score(y_true, y_pred)
    data = [mae, mse, rmse, r2]
    return data

for i, predict in enumerate(predicts):
    data = performance_calculate(y_test, predict)
    series.append(data)
```

```
df = pd.DataFrame(data=series, index=algorithm_names, columns=metrics)
df.head()
```

[421]:

	mean_absolute_error	mean_squared_error	root_mean_squared_error	r2_score
LinearRegression	4.286035e-07	4.741155e-13	6.885604e-07	1.000000
DecisionTreeRegressor	1.233006e+07	8.661541e+14	2.943050e+07	0.839176
RandomForestRegressor	1.034440e+07	6.717967e+14	2.591904e+07	0.875264
SVR	3.878991e+07	5.436136e+15	7.373016e+07	-0.009360
GradientBoostingRegressor	1.024139e+07	5.060532e+14	2.249563e+07	0.906038