zaman-serisi-xgboost

January 2, 2024

```
[1]: import numpy as np
     import pandas as pd
     import matplotlib.pyplot as plt
     import seaborn as sns
```

```
[2]: train=pd.read_csv("C:\\Users\\Dell\\Desktop\\Store Sales (Time Series)\\train.
       ↪csv")
     test=pd.read_csv("C:\\Users\\Dell\\Desktop\\Store Sales (Time Series)\\test.
       ↪csv")
     holiday_events=pd.read_csv("C:\\Users\\Dell\\Desktop\\Store Sales (Time␣
       ↪Series)\\holidays_events.csv")
     oil=pd.read_csv("C:\\Users\\Dell\\Desktop\\Store Sales (Time Series)\\oil.csv")
     stores=pd.read_csv("C:\\Users\\Dell\\Desktop\\Store Sales (Time Series)\\stores.
       ↪csv")
     transactions=pd.read_csv("C:\\Users\\Dell\\Desktop\\Store Sales (Time␣
       ↪Series)\\transactions.csv")
```

0.1 Verilerin Analizi

```
[3]: display("Train",train.head(3),train.tail(3),train.shape,train.isnull().
       ↪sum(),"*"*70)
     display("Test",test.head(3),test.tail(3),test.shape,test.isnull().sum(),"*"*70)
     display("Holiday Events",holiday_events.head(3),holiday_events.
       ↪tail(3),holiday_events.shape,holiday_events.isnull().sum(),"*"*70)
     display("Oil",oil.head(3),oil.tail(3),oil.shape,oil.isnull().sum(),"*"*70)
     display("Stores",stores.head(3),stores.tail(3),stores.shape,stores.isnull().
       ↪sum(),"*"*70)
     display("Transactions",transactions.head(3),transactions.tail(3),transactions.
       ↪shape,transactions.isnull().sum(),"*"*70)
```

```
'Train'

   id        date  store_nbr      family  sales  onpromotion
0   0  2013-01-01          1  AUTOMOTIVE    0.0            0
1   1  2013-01-01          1   BABY CARE    0.0            0
2   2  2013-01-01          1      BEAUTY    0.0            0
```

```
              id        date  store_nbr                      family     sales  \
3000885  3000885  2017-08-15          9                     PRODUCE  2419.729
3000886  3000886  2017-08-15          9  SCHOOL AND OFFICE SUPPLIES   121.000
3000887  3000887  2017-08-15          9                     SEAFOOD    16.000

         onpromotion
3000885          148
3000886            8
3000887            0
```

```
(3000888, 6)
```

```
id             0
date           0
store_nbr      0
family         0
sales          0
onpromotion    0
dtype: int64
```

```
'**********************************************************************'
```

```
'Test'
```

```
        id        date  store_nbr      family  onpromotion
0  3000888  2017-08-16          1  AUTOMOTIVE            0
1  3000889  2017-08-16          1   BABY CARE            0
2  3000890  2017-08-16          1      BEAUTY            2
```

```
            id        date  store_nbr                      family  onpromotion
28509  3029397  2017-08-31          9                     PRODUCE            1
28510  3029398  2017-08-31          9  SCHOOL AND OFFICE SUPPLIES            9
28511  3029399  2017-08-31          9                     SEAFOOD            0
```

```
(28512, 5)
```

```
id             0
date           0
store_nbr      0
family         0
onpromotion    0
dtype: int64
```

```
'**********************************************************************'
```

```
'Holiday Events'
```

```
         date     type    locale locale_name                    description  \
0  2012-03-02  Holiday     Local       Manta             Fundacion de Manta
1  2012-04-01  Holiday  Regional    Cotopaxi  Provincializacion de Cotopaxi
2  2012-04-12  Holiday     Local      Cuenca            Fundacion de Cuenca

   transferred
```

```
0        False
1        False
2        False
```

```
           date        type    locale locale_name description  transferred
347  2017-12-24  Additional  National     Ecuador   Navidad-1        False
348  2017-12-25     Holiday  National     Ecuador     Navidad        False
349  2017-12-26  Additional  National     Ecuador   Navidad+1        False
```

```
(350, 6)
```

```
date           0
type           0
locale         0
locale_name    0
description    0
transferred    0
dtype: int64
```

```
'**********************************************************************'
```

```
'Oil'
```

```
         date  dcoilwtico
0  2013-01-01         NaN
1  2013-01-02       93.14
2  2013-01-03       92.97
```

```
            date  dcoilwtico
1215  2017-08-29       46.46
1216  2017-08-30       45.96
1217  2017-08-31       47.26
```

```
(1218, 2)
```

```
date           0
dcoilwtico    43
dtype: int64
```

```
'**********************************************************************'
```

```
'Stores'
```

```
   store_nbr   city      state type  cluster
0          1  Quito  Pichincha    D       13
1          2  Quito  Pichincha    D       13
2          3  Quito  Pichincha    D        8
```

```
    store_nbr       city   state type  cluster
51         52      Manta  Manabi    A       11
52         53      Manta  Manabi    D       13
53         54  El Carmen  Manabi    C        3
```

```
(54, 5)
```

```
store_nbr    0
city         0
state        0
type         0
cluster      0
dtype: int64
```

```
'**********************************************************************'
```

```
'Transactions'
```

```
         date  store_nbr  transactions
0  2013-01-01         25           770
1  2013-01-02          1          2111
2  2013-01-02          2          2358
```

```
             date  store_nbr  transactions
83485  2017-08-15         52          2255
83486  2017-08-15         53           932
83487  2017-08-15         54           802
```

```
(83488, 3)
```

```
date            0
store_nbr       0
transactions    0
dtype: int64
```

```
'**********************************************************************'
```

[4]:

```
display(train.info(),"*"*70)
display(test.info(),"*"*70)
display(holiday_events.info(),"*"*70)
display(oil.info(),"*"*70)
display(stores.info(),"*"*70)
display(transactions.info(),"*"*70)
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3000888 entries, 0 to 3000887
Data columns (total 6 columns):
 #   Column       Dtype
---  ------       -----
 0   id           int64
 1   date         object
 2   store_nbr    int64
 3   family       object
 4   sales        float64
 5   onpromotion  int64
dtypes: float64(1), int64(3), object(2)
memory usage: 137.4+ MB
```

```
None
```

```
'**********************************************************************'

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 28512 entries, 0 to 28511
Data columns (total 5 columns):
 #   Column       Non-Null Count  Dtype 
---  ------       --------------  ----- 
 0   id           28512 non-null  int64 
 1   date         28512 non-null  object
 2   store_nbr    28512 non-null  int64 
 3   family       28512 non-null  object
 4   onpromotion  28512 non-null  int64 
dtypes: int64(3), object(2)
memory usage: 1.1+ MB

None

'**********************************************************************'

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 350 entries, 0 to 349
Data columns (total 6 columns):
 #   Column       Non-Null Count  Dtype 
---  ------       --------------  ----- 
 0   date         350 non-null    object
 1   type         350 non-null    object
 2   locale       350 non-null    object
 3   locale_name  350 non-null    object
 4   description  350 non-null    object
 5   transferred  350 non-null    bool  
dtypes: bool(1), object(5)
memory usage: 14.1+ KB

None

'**********************************************************************'

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1218 entries, 0 to 1217
Data columns (total 2 columns):
 #   Column      Non-Null Count  Dtype  
---  ------      --------------  -----  
 0   date        1218 non-null   object 
 1   dcoilwtico  1175 non-null   float64
dtypes: float64(1), object(1)
memory usage: 19.2+ KB

None

'**********************************************************************'

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 54 entries, 0 to 53
```

```
Data columns (total 5 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   store_nbr  54 non-null     int64
 1   city       54 non-null     object
 2   state      54 non-null     object
 3   type       54 non-null     object
 4   cluster    54 non-null     int64
dtypes: int64(2), object(3)
memory usage: 2.2+ KB
```

```
None
```

```
'**********************************************************************'
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 83488 entries, 0 to 83487
Data columns (total 3 columns):
 #   Column        Non-Null Count  Dtype
---  ------        --------------  -----
 0   date          83488 non-null  object
 1   store_nbr     83488 non-null  int64
 2   transactions  83488 non-null  int64
dtypes: int64(2), object(1)
memory usage: 1.9+ MB
```

```
None
```

```
'**********************************************************************'
```

[5]:

```
train["date"]=pd.to_datetime(train["date"],format="%Y-%m-%d")
test["date"]=pd.to_datetime(test["date"],format="%Y-%m-%d")
holiday_events["date"]=pd.to_datetime(holiday_events["date"],format="%Y-%m-%d")
oil["date"]=pd.to_datetime(oil["date"],format="%Y-%m-%d")
transactions["date"]=pd.to_datetime(transactions["date"],format="%Y-%m-%d")
```

[6]:

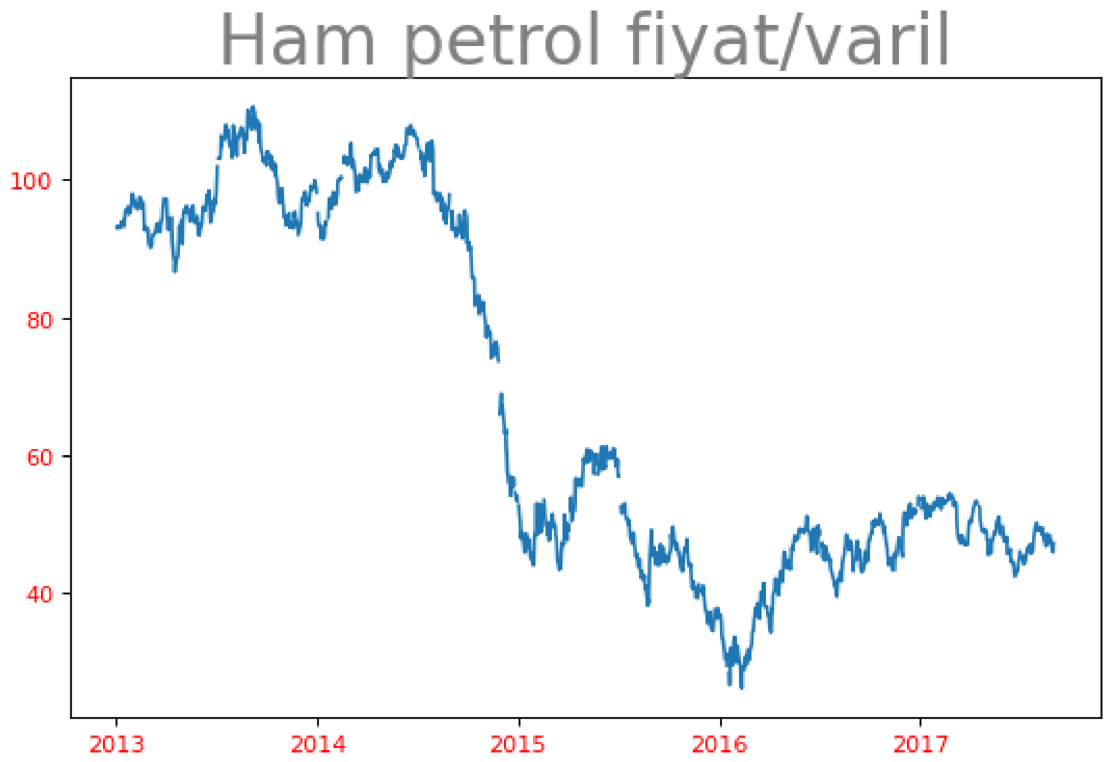
```
print("train: ",train["date"].min()," ",train["date"].max(),
      "\ntest: ",test["date"].min()," ",test["date"].max(),
      "\nholiday: ",holiday_events["date"].min()," ",holiday_events["date"].
 ↪max(),
      "\noil: ",oil["date"].min()," ",oil["date"].max(),
      "\ntransactions: ",transactions["date"].min()," ",transactions["date"].
 ↪max())
```

```
train:  2013-01-01 00:00:00   2017-08-15 00:00:00
test:  2017-08-16 00:00:00   2017-08-31 00:00:00
holiday:  2012-03-02 00:00:00   2017-12-26 00:00:00
oil:  2013-01-01 00:00:00   2017-08-31 00:00:00
transactions:  2013-01-01 00:00:00   2017-08-15 00:00:00
```

0.1.1 Oil verisinin azalizi

[7]:

```
plt.figure(figsize=(8,5), dpi= 80)
plt.plot('date', 'dcoilwtico', data=oil, color='tab:blue')
plt.title('Ham petrol fiyat/varil', fontsize=30, color ='gray' )
plt.xticks(color='red')
plt.yticks(color='red')
plt.show()
```

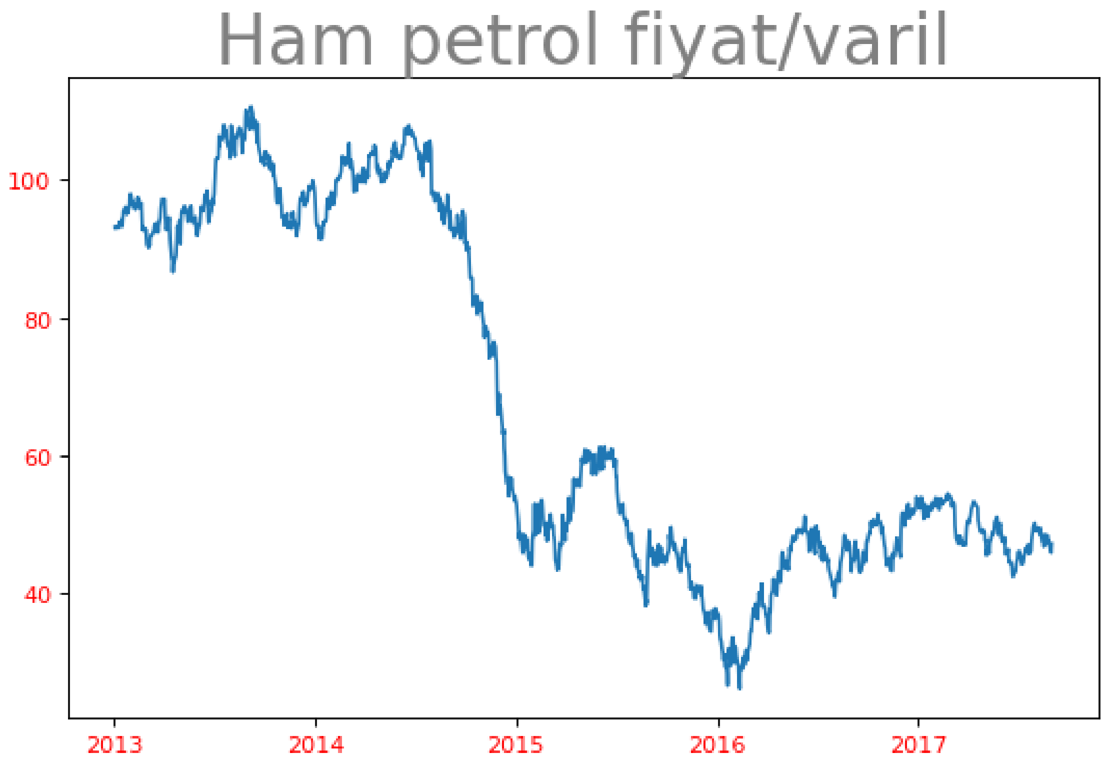


[8]:

```
oil.dcoilwtico = oil.dcoilwtico.interpolate(method="polynomial", order=2,␣
 ↪limit_direction="both")
```

[9]:

```
plt.figure(figsize=(8,5), dpi= 80)
plt.plot('date', 'dcoilwtico', data=oil, color='tab:blue')
plt.title('Ham petrol fiyat/varil', fontsize=30, color ='grey' )
plt.xticks(color='red')
plt.yticks(color='red')
plt.show()
```



```
[10]: oil.isnull().sum()
```

```
[10]: date          0
      dcoilwtico    1
      dtype: int64
```

```
[11]: oil.isnull()
```

```
[11]:       date  dcoilwtico
      0     False        True
      1     False       False
      2     False       False
      3     False       False
      4     False       False
      …     …          …
      1213  False       False
      1214  False       False
      1215  False       False
      1216  False       False
      1217  False       False

      [1218 rows x 2 columns]
```

[12]:

```
oil.iloc[0:1,1:]=oil.iloc[1:2,1:2]
oil.head()
```

[12]:

```
         date  dcoilwtico
0  2013-01-01       93.14
1  2013-01-02       93.14
2  2013-01-03       92.97
3  2013-01-04       93.12
4  2013-01-07       93.20
```

[13]:

```
oil.isnull().sum()
```

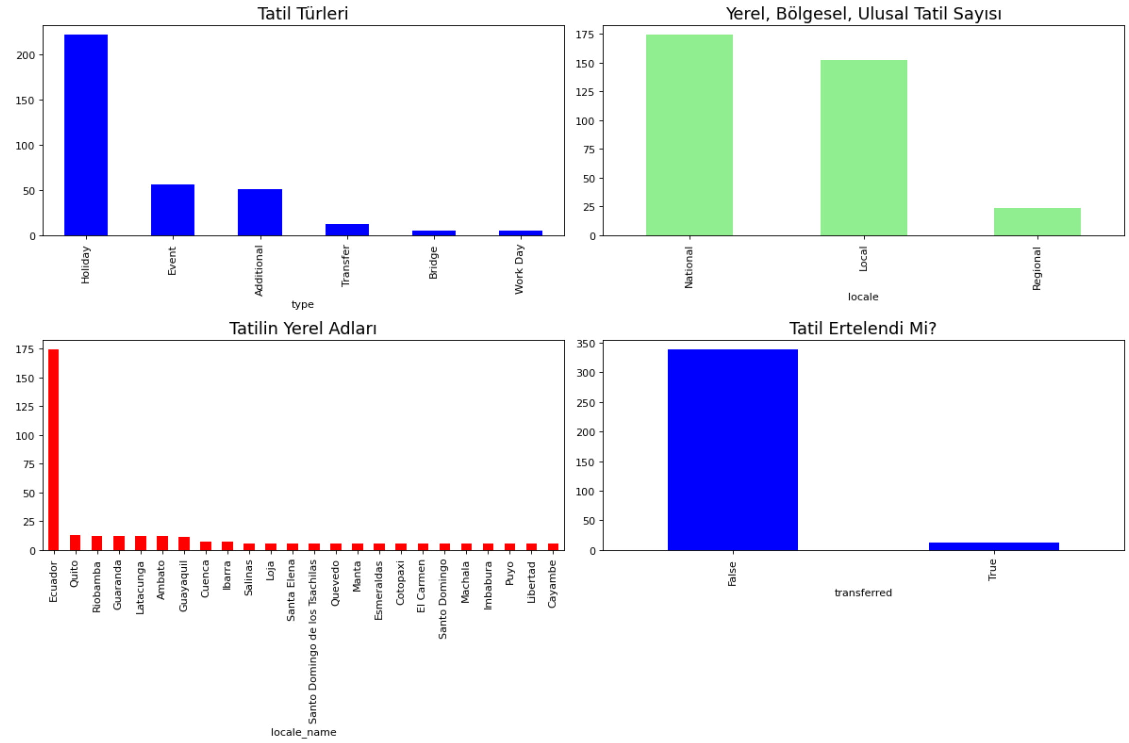
[13]:

```
date          0
dcoilwtico    0
dtype: int64
```

0.1.2 Holiday verisinin analizi

[14]:

```
plt.figure(figsize=(15, 10), dpi=80)

plt.subplot(2, 2, 1)
holiday_events['type'].value_counts().plot.bar(color='blue')
plt.title('Tatil Türleri',fontsize=16)

plt.subplot(2, 2, 2)
holiday_events['locale'].value_counts().plot.bar(color='lightgreen')
plt.title('Yerel, Bölgesel, Ulusal Tatil Sayısı',fontsize=16)

plt.subplot(2, 2, 3)
holiday_events['locale_name'].value_counts().plot.bar(color='red')
plt.title('Tatilin Yerel Adları',fontsize=16)

plt.subplot(2, 2, 4)
holiday_events['transferred'].value_counts().plot.bar(color='blue')
plt.title('Tatil Ertelendi Mi?',fontsize=16)

plt.tight_layout()
plt.show()
```



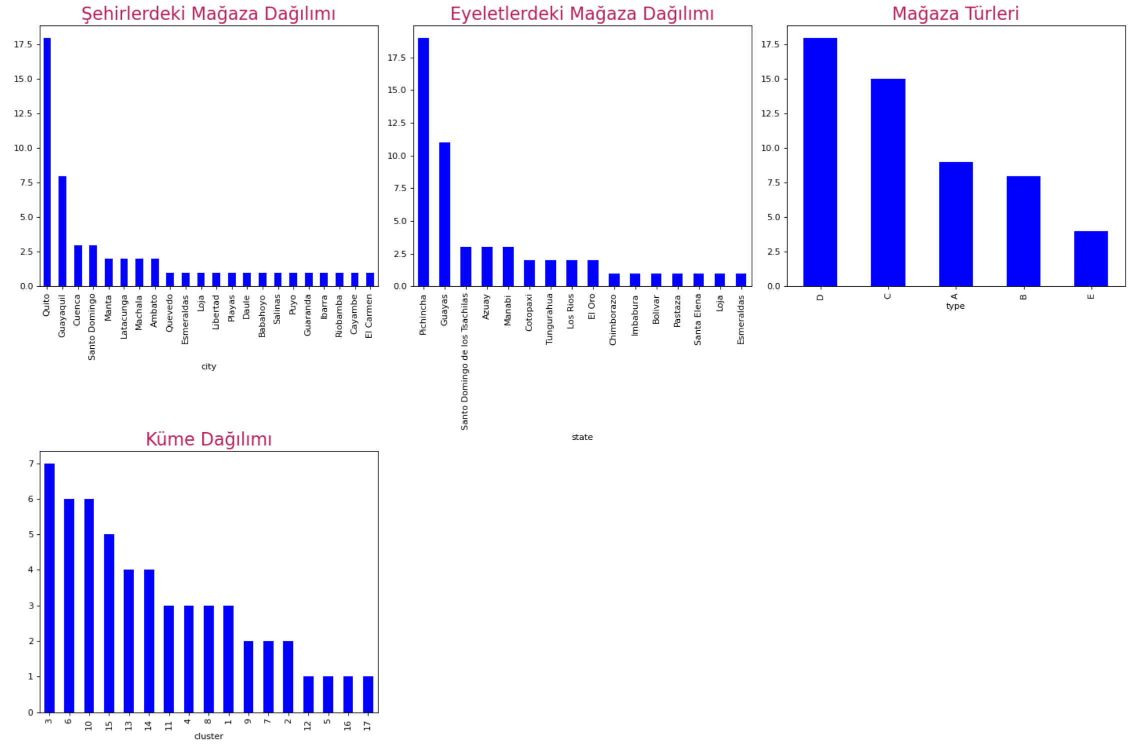
0.1.3 Store verisinin analizi

[15]:
```
stores.head(10)
```

[15]:
```
   store_nbr           city                           state type  cluster
0          1          Quito                       Pichincha    D       13
1          2          Quito                       Pichincha    D       13
2          3          Quito                       Pichincha    D        8
3          4          Quito                       Pichincha    D        9
4          5  Santo Domingo  Santo Domingo de los Tsachilas    D        4
5          6          Quito                       Pichincha    D       13
6          7          Quito                       Pichincha    D        8
7          8          Quito                       Pichincha    D        8
8          9          Quito                       Pichincha    B        6
9         10          Quito                       Pichincha    C       15
```

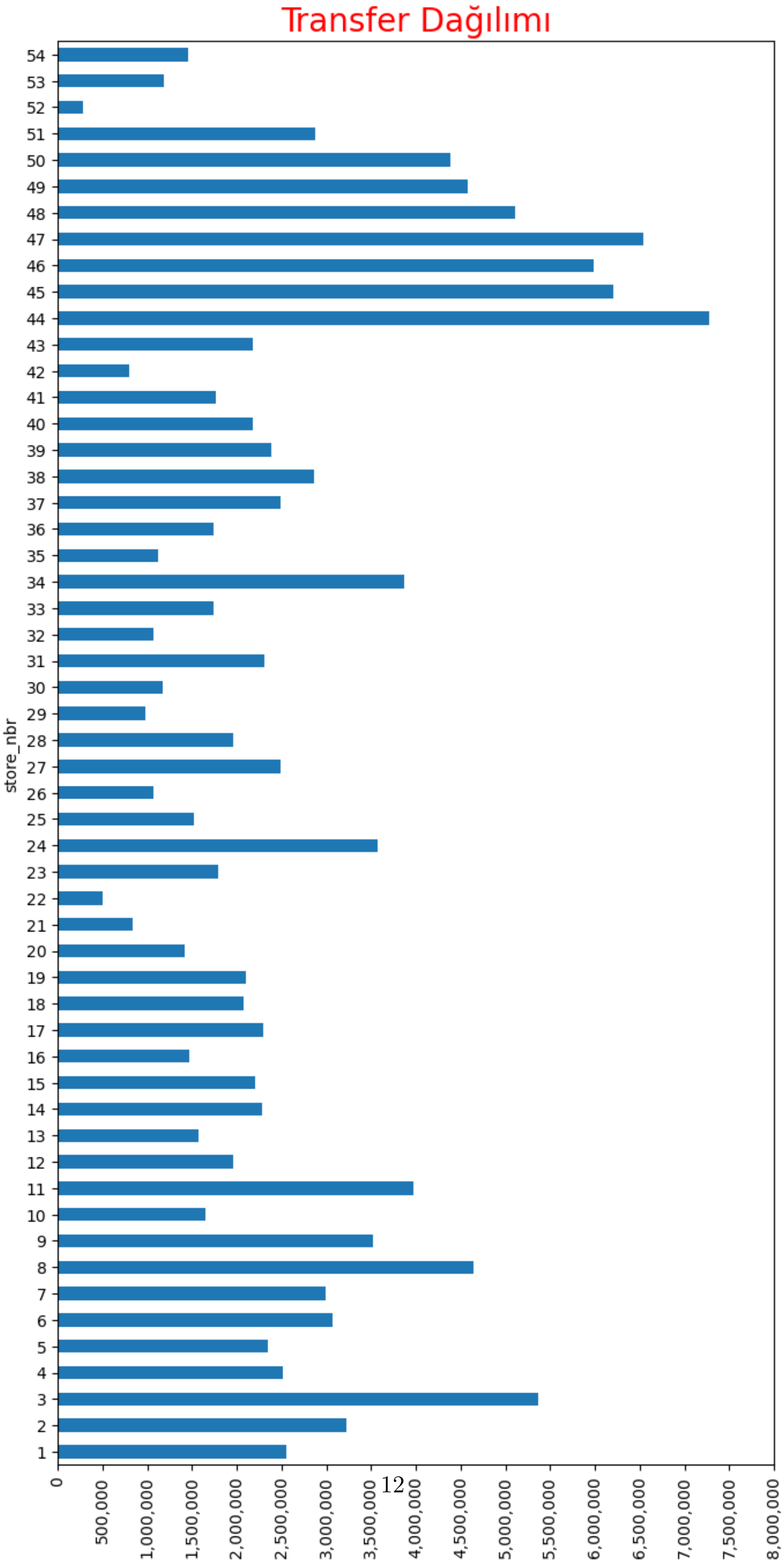
[16]:
```
plt.figure(figsize=(18, 12), dpi= 80)

plt.subplot (2, 3, 1)
stores["city"].value_counts().plot.bar(color="blue")
plt.title ("Şehirlerdeki Mağaza Dağılımı", fontsize=20, color='#b71f5c')

plt.subplot (2, 3, 2)
```

```
stores["state"].value_counts().plot.bar(color="blue")
plt.title ("Eyeletlerdeki Mağaza Dağılımı", fontsize=20, color='#b71f5c')

plt.subplot (2, 3, 3)
stores["type"].value_counts().plot.bar(color="blue")
plt.title ("Mağaza Türleri", fontsize=20, color='#b71f5c')

plt.subplot (2, 3, 4)
stores["cluster"].value_counts().plot.bar(color="blue")
plt.title ("Küme Dağılımı", fontsize=20, color='#b71f5c')

plt.tight_layout()
plt.show()
```



0.1.4 Transactions verisinin analizi

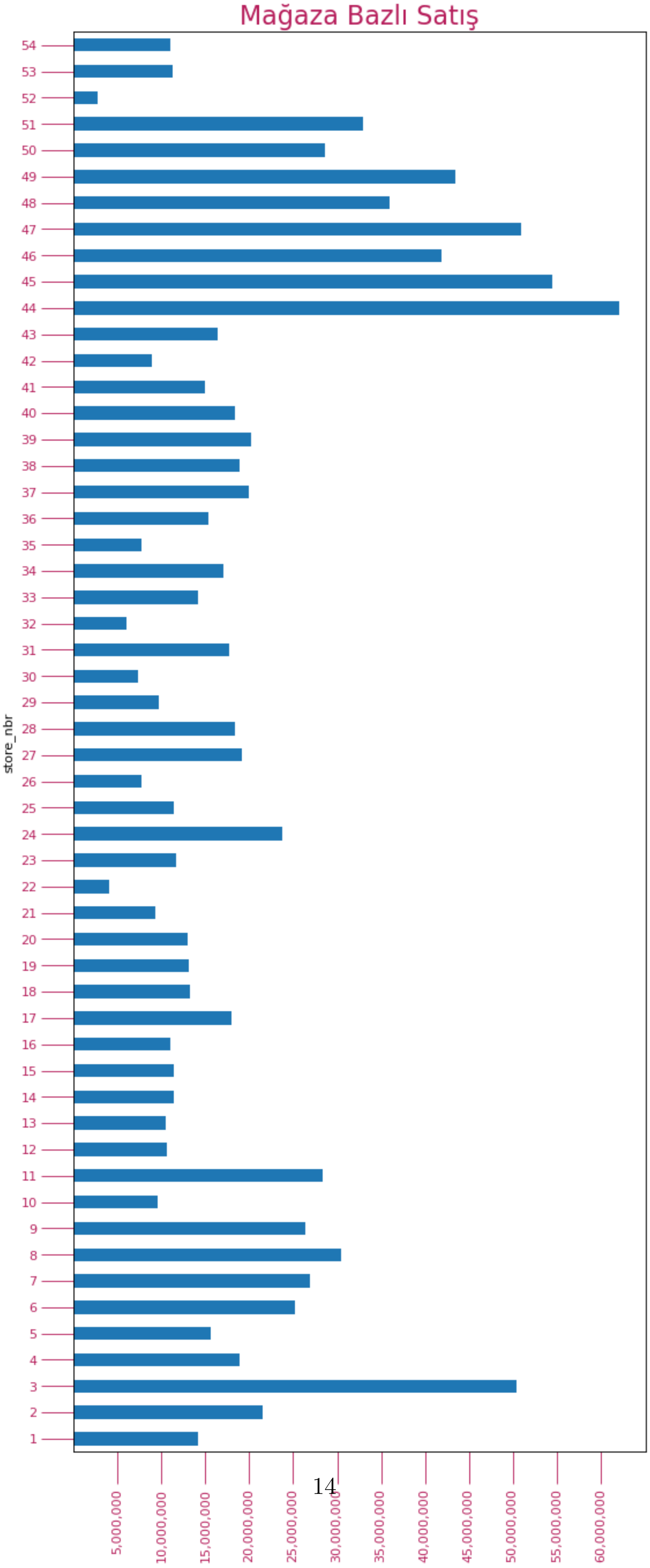
[17]:
```
t_groups=transactions.groupby("store_nbr")["transactions"].sum()
fig, ax=plt.subplots(figsize=(8,16),dpi=100)
t_groups.plot.barh()
plt.title("Transfer Dağılımı", fontsize=20, color="red")
xticks=range(0, max(t_groups)+1000000, 500000)
plt.xticks(xticks, [f'{val:,}' for val in xticks], rotation=90)
plt.show()
```

Transfer Dağılımı
store_nbr
54
53
52
51
50
49
48
47
46
45
44
43
42
41
40
39
38
37
36
35
34
33
32
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
500,000
1,000,000
1,500,000
2,000,000
2,500,000
3,000,000
3,500,000
4,000,000
4,500,000
5,000,000
5,500,000
6,000,000
6,500,000
7,000,000
7,500,000
8,000,000

0.1.5 Train verisi analizi

[18]:

```
colors = ['#f47e7a', '#b71f5c', '#621237', '#dbbaa7']
font_color = '#525252'
csfont = {'fontname':'Georgia'}
fig, ax = plt.subplots(figsize=(8, 20), dpi= 80)
sales_stores = train.groupby('store_nbr')['sales'].sum()
sales_stores.plot.barh()
plt.title ("Mağaza Bazlı Satış", fontsize=20, color='#b71f5c')
xticks = range(5000000, 60000001, 5000000)
plt.xticks(xticks, [f'{val:,}' for val in xticks], rotation=90)
ax.tick_params(axis='x', colors='#b71f5c', size=25)
ax.tick_params(axis='y', colors='#b71f5c', size=25)
plt.show()
```


Mağaza Bazlı Satış
store_nbr
54
53
52
51
50
49
48
47
46
45
44
43
42
41
40
39
38
37
36
35
34
33
32
31
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22
21
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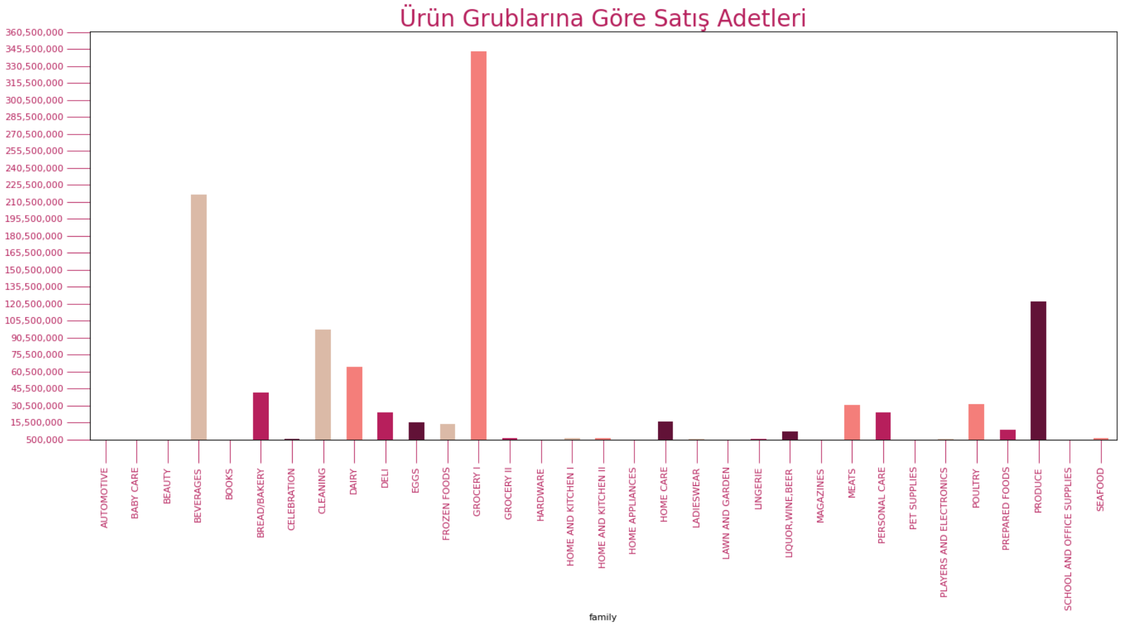
12
11
10
9
8
7
6
5
4
3
2
1
5,000,000
10,000,000
15,000,000
20,000,000
25,000,000
30,000,000
35,000,000
40,000,000
45,000,000
50,000,000
55,000,000
60,000,000

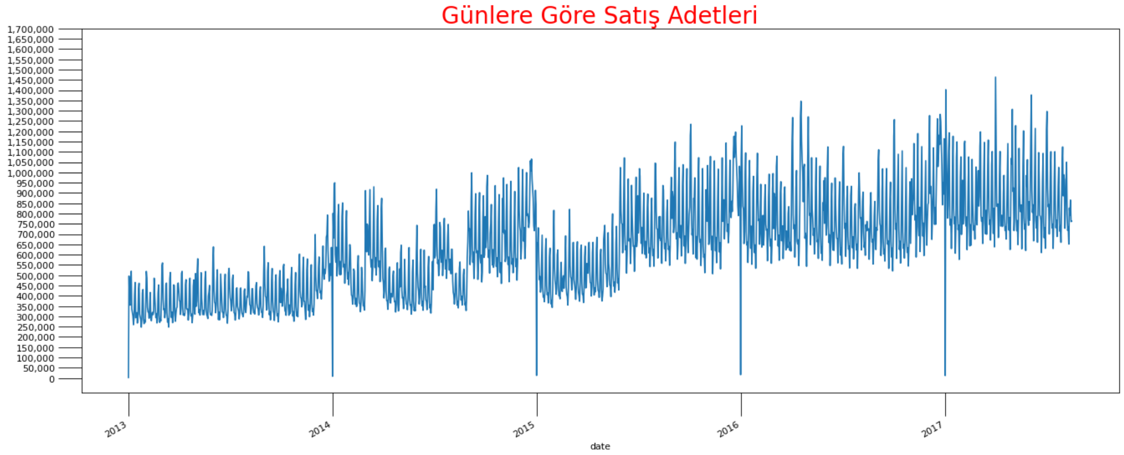
[19]:

```
fig, ax = plt.subplots(figsize=(20, 8), dpi= 80)
sales_type_y = train.groupby(['family'])['sales'].sum()
sales_type_y.plot.bar(color=colors)
plt.title ("Ürün Grublarına Göre Satış Adetleri", fontsize=25, color='#b71f5c')
yticks = range(500000, 370000001, 15000000)
plt.yticks(yticks, [f'{val:,}' for val in yticks])
ax.tick_params(axis='x', colors='#b71f5c', size=25)
ax.tick_params(axis='y', colors='#b71f5c',size=25)
plt.show()
```

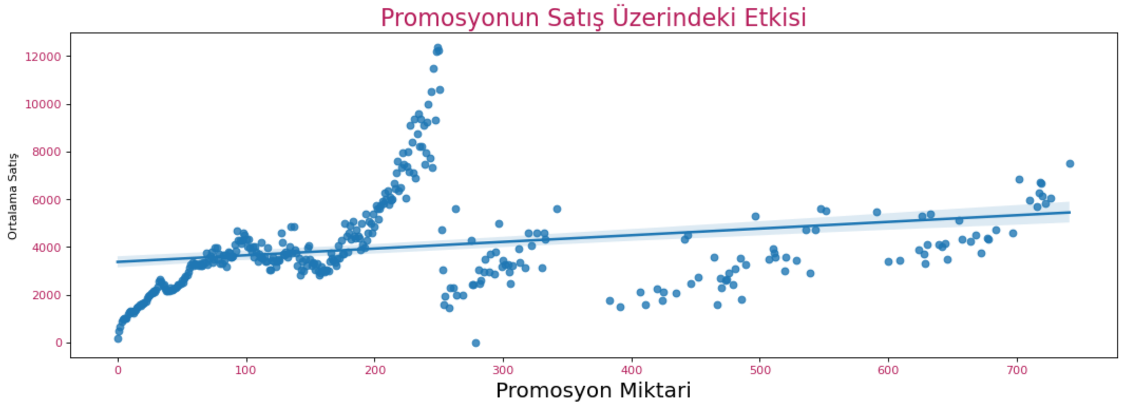


[20]:

```
fig, ax = plt.subplots(figsize=(20, 8), dpi= 80)
sales_date = train.groupby(['date'])['sales'].sum()
sales_date.plot()
plt.title ("Günlere Göre Satış Adetleri", fontsize=25, color='red')
yticks = range(0, 1750000, 50000)
plt.yticks(yticks, [f'{val:,}' for val in yticks])
ax.tick_params(axis='x', size=25)
ax.tick_params(axis='y', size=25)
plt.show()
```



[21]:
```
promote_sales = train.groupby(['onpromotion'], as_index=False)['sales'].mean()
plt.figure(figsize=(16, 5), dpi=80)
sns.regplot(x=promote_sales.onpromotion, y=promote_sales.sales)
plt.ylabel("Ortalama Satış")
plt.title("Promosyonun Satış Üzerindeki Etkisi", fontsize=20, color='#b71f5c')
plt.xticks(color='#b71f5c', size=10)
plt.yticks(color='#b71f5c', size=10)
plt.xlabel('Promosyon Miktari', fontsize=18)
plt.show()
```

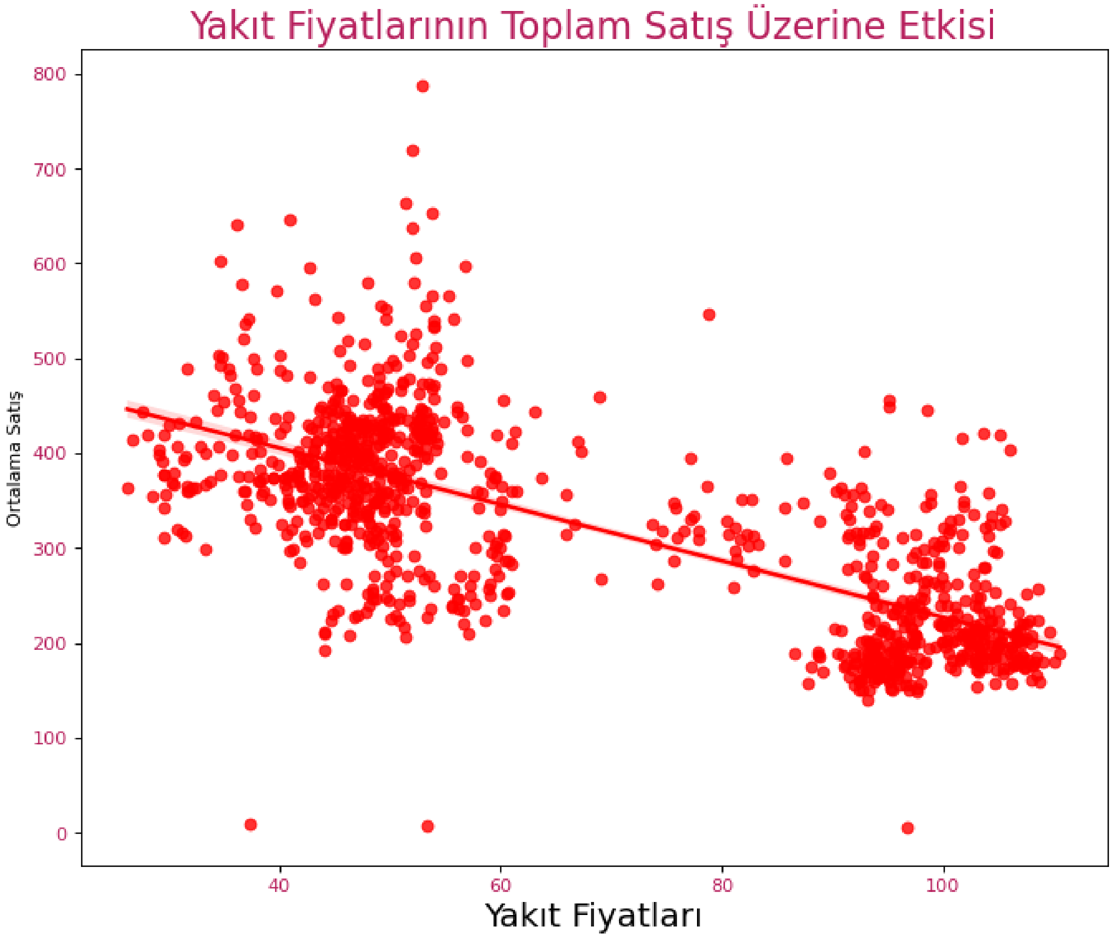


Promosyon miktarının 250 den sonra ortalama satışın fazla olmadığı gözlenmektedir.

[22]:
```
holiday_events=holiday_events.drop_duplicates(subset=['date'], keep='last')
train=pd.merge(train,holiday_events,how="left",on=["date"])
train=pd.merge(train,stores,how="left",on=["store_nbr"])
train=pd.merge(train,oil,how="left",on=["date"])
```

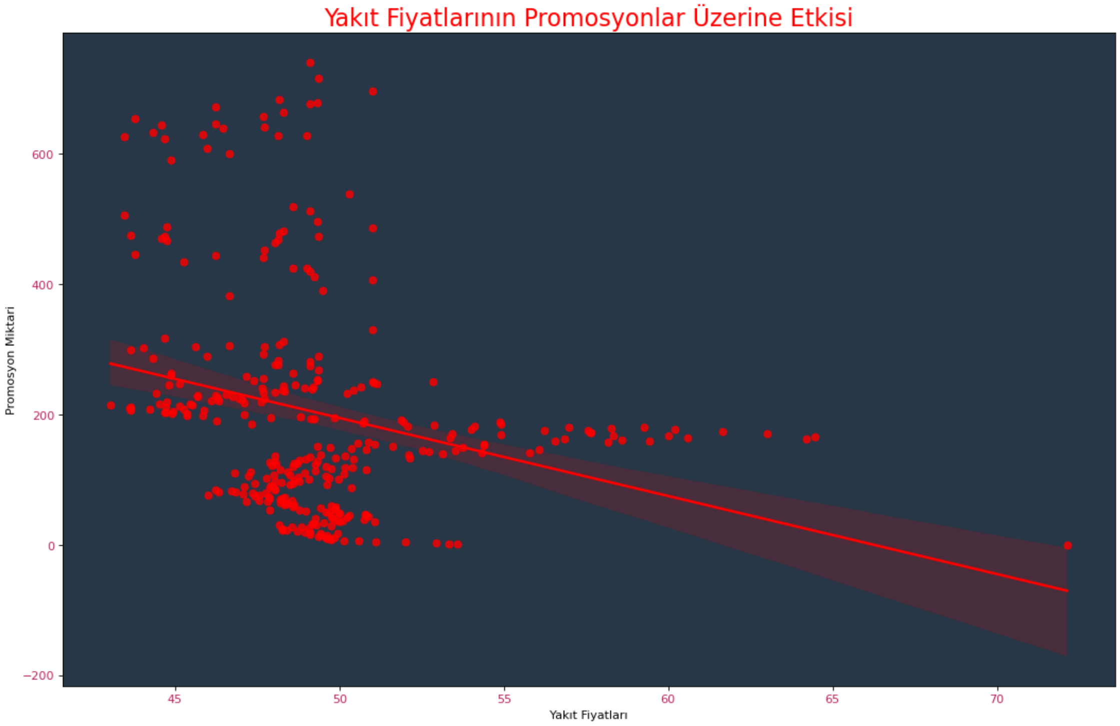
```
[23]: train['day'] = train['date'].dt.day_of_week
      train['month'] = train['date'].dt.month
      train['year'] = train['date'].dt.year
```

```
[24]: sales_oil = train.groupby(['dcoilwtico'], as_index=False)['sales'].mean()
      plt.figure(figsize=(10, 8), dpi=80)
      sns.regplot(x=sales_oil.dcoilwtico, y=sales_oil.sales, color='red')
      plt.ylabel("Ortalama Satış")
      plt.title("Yakıt Fiyatlarının Toplam Satış Üzerine Etkisi", fontsize=20,␣
        ↪color='#b71f5c')
      #plt.gca().set_facecolor('#283747')
      plt.xticks(color='#b71f5c', size=10)
      plt.yticks(color='#b71f5c', size=10)
      plt.xlabel('Yakıt Fiyatları', fontsize=18)
      plt.show()
```



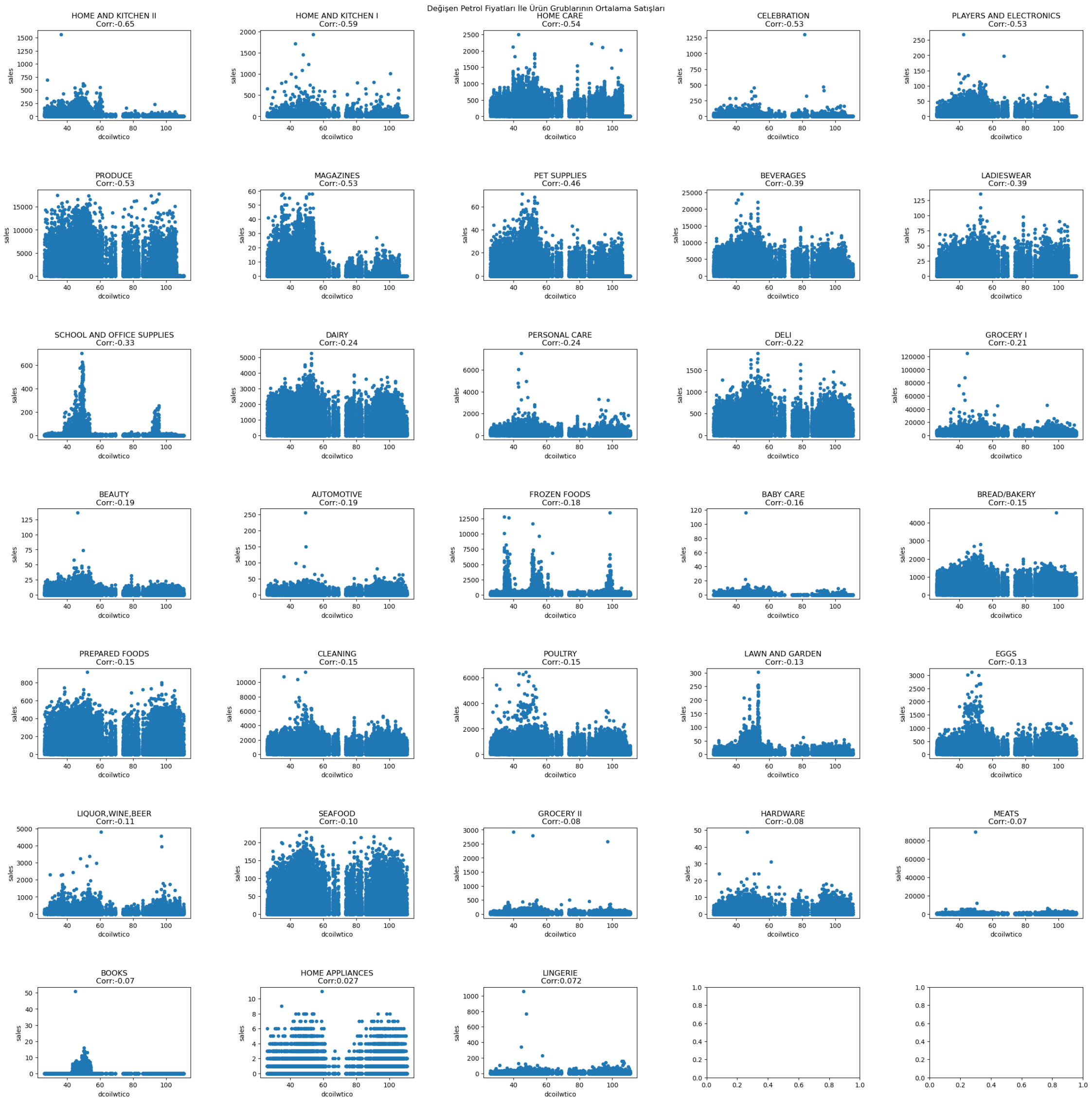
Yakıt fiyatlarının düşük olduğu zamanlarda ortalama satış daha fazla görülmektedir ama yüksek olduğu dönemlerde de belli bir ortalamaya sahip. Bu durum yakıt fiyatlarının uzun bir dönem boyunca devam etmesi veya yapılan promosyonlar ile ilgili olabilir.

[25]:
```
promotion_oil=train.groupby("onpromotion",as_index=False)["dcoilwtico"].mean()
plt.figure(figsize=(16,10), dpi=80)
sns.regplot(x=promotion_oil.dcoilwtico, y=promotion_oil.onpromotion,␣
  ↪color="red")
plt.ylabel("Promosyon Miktari")
plt.xlabel("Yakıt Fiyatları")
plt.title("Yakıt Fiyatlarının Promosyonlar Üzerine␣
  ↪Etkisi",fontsize=20,color="red")
plt.gca().set_facecolor('#283747')
plt.xticks(color='#b71f5c', size=10)
plt.yticks(color='#b71f5c', size=10)
plt.show()
```



Yakıt fiyatlarının 80 doların üzerinde iken hiçbir promosyan verilmediği gözlenmektedir. Buda bize yakıt fiyatlarının düşük iken yapılan satışların ortalamasın daha çok olmasının sebebini yapılan promosyanlardan kaynaklandığı anlamını vermektedir.

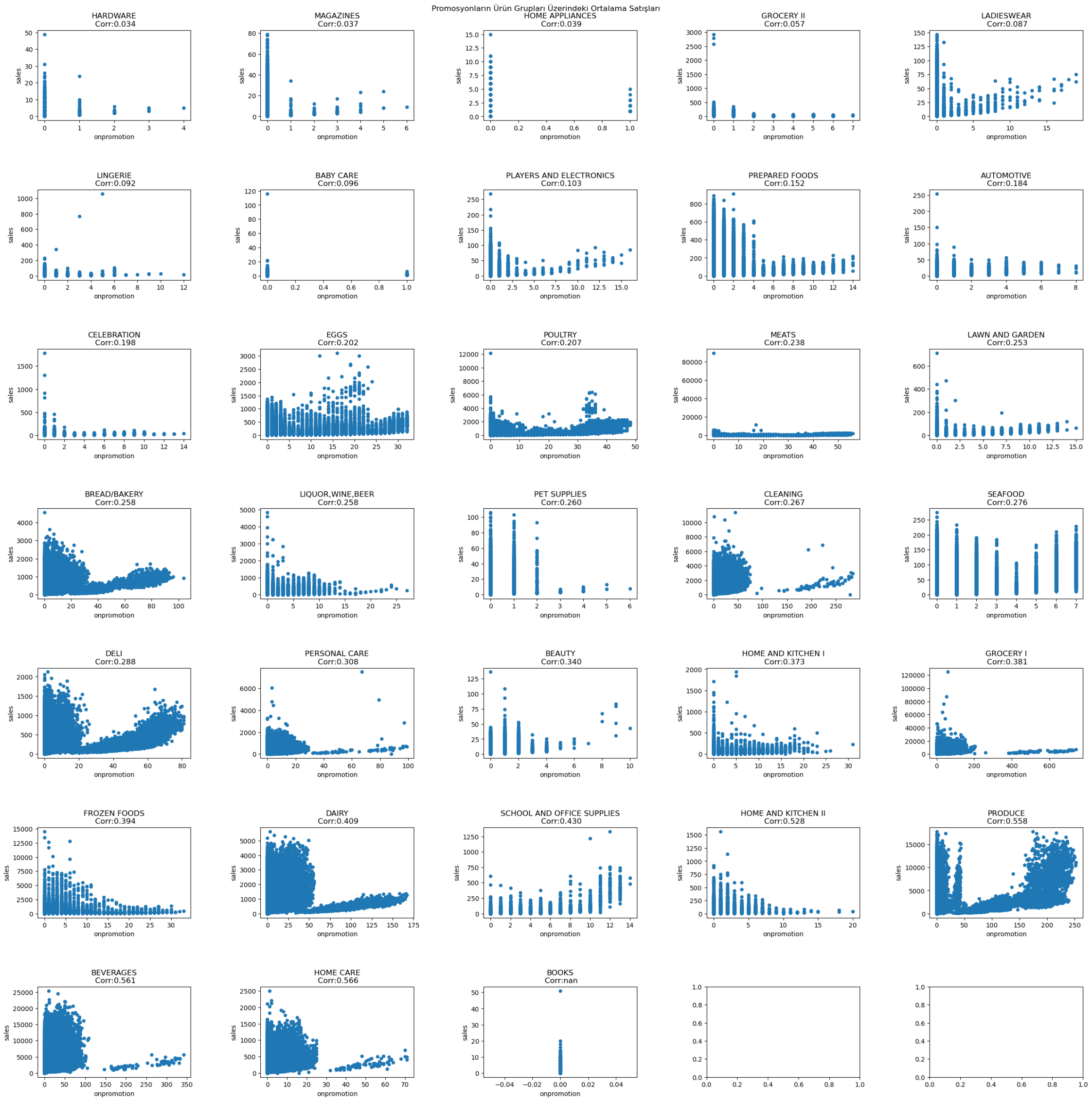
[26]:
```
corr_train_oil = train.groupby("family").corr("spearman", numeric_only=True).
  ↪reset_index()
corr_train_oil = corr_train_oil[corr_train_oil['level_1'] ==␣
  ↪"dcoilwtico"][["family", "sales"]].sort_values("sales")

fig, axes = plt.subplots(7, 5, figsize=(25, 25))

for i, j in enumerate(corr_train_oil['family']):
    train[train['family'] == j].plot.scatter(x="dcoilwtico", y="sales",␣
↪ax=axes[i // 5, i % 5])
    axes[i // 5, i % 5].set_title(j + "\n Corr:" +␣
↪str(corr_train_oil[corr_train_oil.family == j].sales.iloc[0])[:5])

plt.tight_layout(pad=5)
plt.suptitle("Değişen Petrol Fiyatları İle Ürün Grublarının Ortalama Satışları")

plt.show()
```



Korelasyon analizine göre yakıt fiyatlarının satışlar üzerine etkisi Home And Kitchen, Magazines, Celebration, Home Care,Players And Electronics, Produce, Pet Suplies ve Ladieswear kategorilerinde orta seviye ilişki görülmektedir. Diğer katogorilerde ise bazılarında zayıf bazılarında ise ilişki yok diyebiliriz.

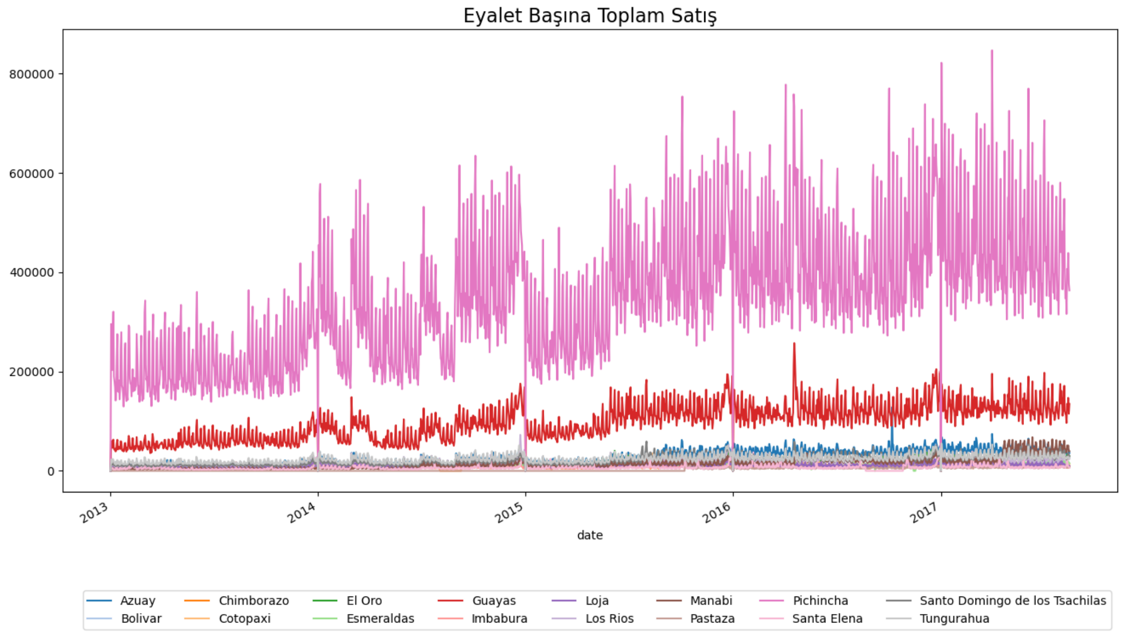
[27]:

```
corr_train_promote = train.groupby("family").corr("spearman",numeric_only=True).
 ↪reset_index()
corr_train_promote = corr_train_promote[corr_train_promote['level_1'] ==␣
 ↪"onpromotion"][["family", "sales"]].sort_values("sales")

fig, axes = plt.subplots(7, 5, figsize=(25, 25))

for i, j in enumerate(corr_train_promote['family']):
    train[train['family'] == j].plot.scatter(x="onpromotion", y="sales",␣
 ↪ax=axes[i // 5, i % 5])
    axes[i // 5, i % 5].set_title(j + "\n Corr:" +␣
 ↪str(corr_train_promote[corr_train_promote.family == j].sales.iloc[0])[:5])

plt.tight_layout(pad=5)
plt.suptitle("Promosyonların Ürün Grupları Üzerindeki Ortalama Satışları")

plt.show()
```

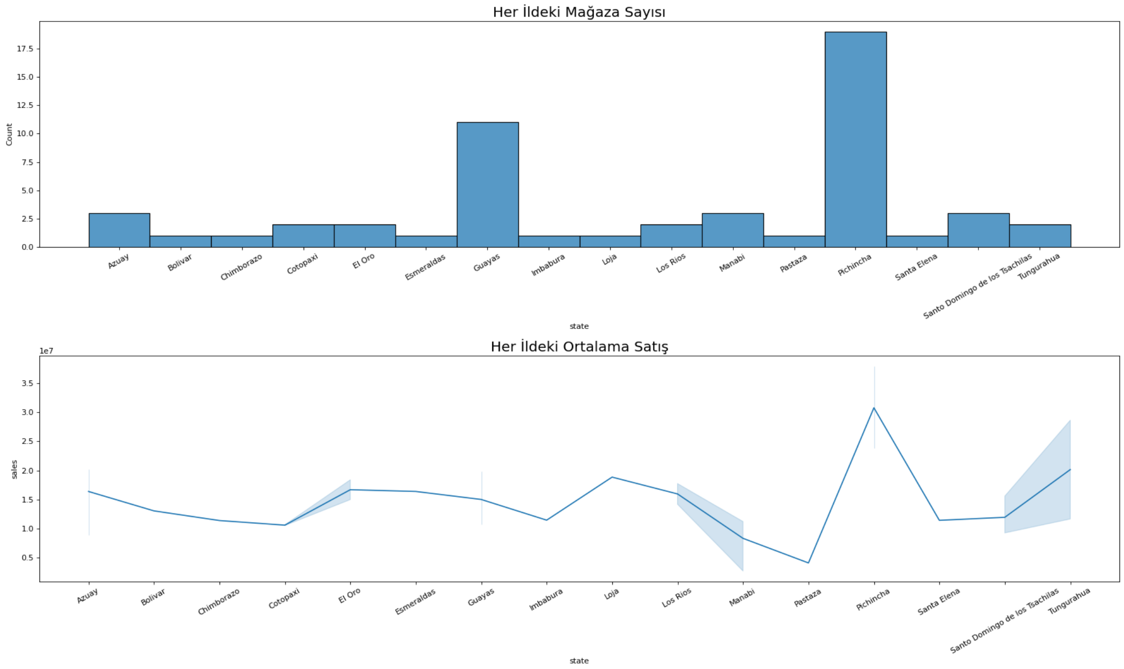


Promasyonların satış üzerindeki etkisini incelediğimizde Home Care, Beverages, Produce, Home And Kitchen, School And Office Supplies ve Dairy kategorilerinde orta seviye ilişki görülmektedir. Diğer katogorilerde ise bazılarında zayıf bazılarında ise ilişki yok diyebiliriz.

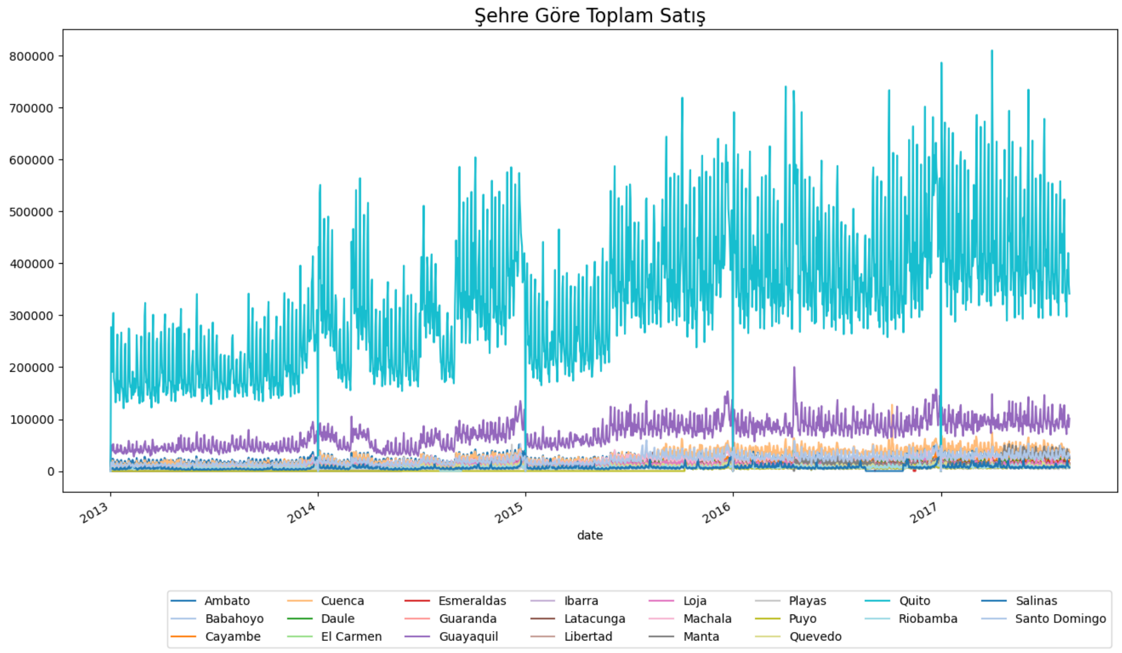
```
[28]: sale_state = train.groupby(['date', 'state'], as_index=False)['sales'].sum()
      sale_state = sale_state.pivot(index='date', columns='state', values='sales')
      colors = plt.cm.tab20.colors
      sale_state.plot(figsize=(16, 8),color=colors)
      plt.title("Eyalet Başına Toplam Satış", fontsize=16)
      plt.xticks(rotation=30)
      plt.legend(bbox_to_anchor=(1, -.2), ncol=8)
      plt.show()
```



[29]:
```
sale_state = train.groupby(['state', 'store_nbr'], as_index=False)['sales'].
  ↪sum()

plt.figure(figsize=(20, 12), dpi=80)
plt.subplot(2, 1, 1)
sns.histplot(sale_state['state'])
plt.xticks(rotation=30)
plt.title('Her İldeki Mağaza Sayısı', fontsize=18)

plt.subplot(2, 1, 2)
sns.lineplot(x=sale_state['state'], y=sale_state['sales'])
plt.xticks(rotation=30)
plt.title('Her İldeki Ortalama Satış', fontsize=18)
plt.tight_layout()
plt.show()
```

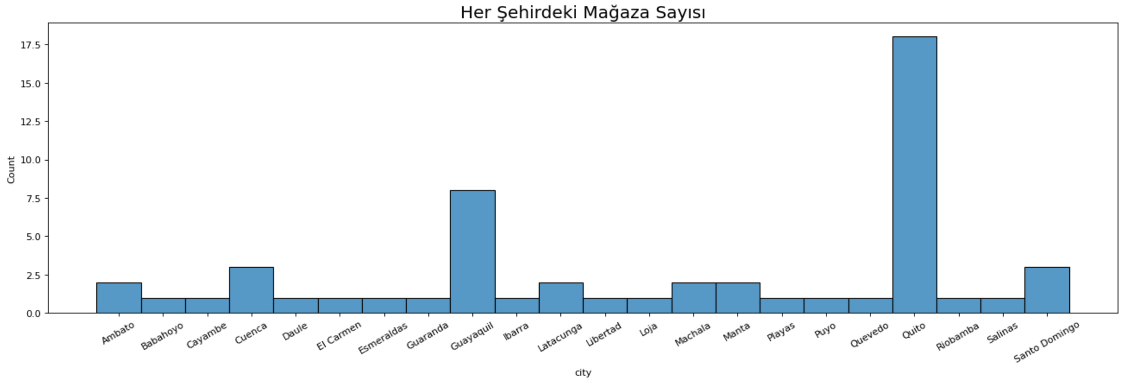


[30]:
```
sale_city = train.groupby(['date', 'city'], as_index=False)['sales'].sum()
sale_city = sale_city.pivot(index='date', columns='city', values='sales')
colors = plt.cm.tab20.colors
sale_city.plot(figsize=(16, 8),color=colors)
plt.title("Şehre Göre Toplam Satış", fontsize=16)
plt.xticks(rotation=30)
plt.legend(bbox_to_anchor=(1, -.2), ncol=8)
plt.show()
```



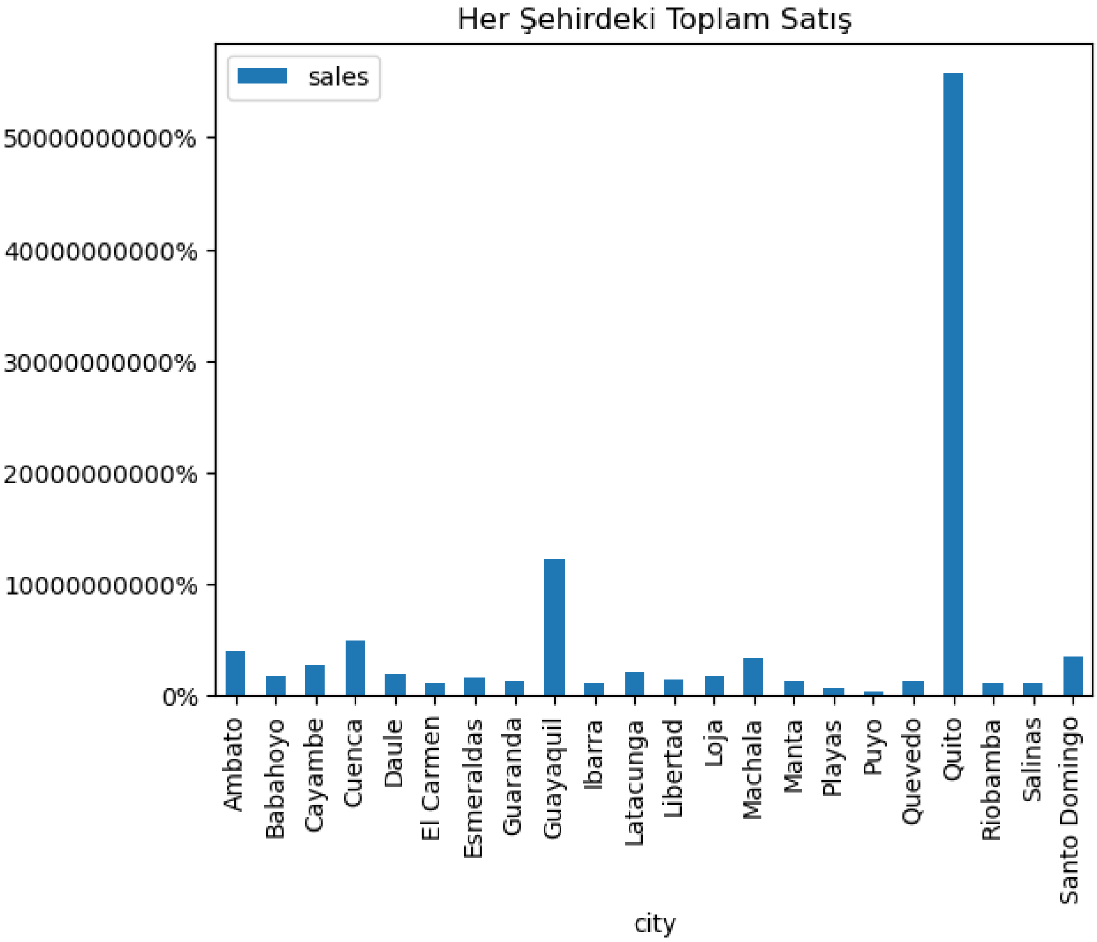
```
[31]: sale_city = train.groupby(['city', 'store_nbr'], as_index=False)['sales'].sum()
      plt.figure(figsize=(20, 12), dpi=80)
      plt.subplot(2, 1, 1)
      sns.histplot(sale_city['city'])
      plt.xticks(rotation=30)
      plt.title('Her Şehirdeki Mağaza Sayısı', fontsize=18)
```

```
[31]: Text(0.5, 1.0, 'Her Şehirdeki Mağaza Sayısı')
```



```
[32]: from matplotlib.ticker import PercentFormatter
      sale_city = train.groupby(['city', 'store_nbr'], as_index=False)['sales'].sum()
      sale_city = sale_city.groupby('city')['sales'].sum().to_frame()
```

```
sale_city.plot.bar()
plt.gca().yaxis.set_major_formatter(PercentFormatter(xmax=1))
plt.title ("Her Şehirdeki Toplam Satış")
plt.show()
```



Eyaletlere ve şehirlere göre mağaza sayısı ve satış adetlerine göre analiz yaptığımızda en çok mağaza sayısı ve satış adetinin Pichincha Eyaletindeki Quito Şehrine ait olduğunu söyleyebiliriz.

[33]:
```
city_to_compare =  'Quito'
df = train.copy()

city_data = df[df['city']==city_to_compare]['sales']
other_cities = df[df['city']!=city_to_compare]['sales']

vr1 = print(city_data.var())
vr2 = print(other_cities.var())

from scipy import stats
```

```
t_statistic, p_value = stats.ttest_ind(city_data, other_cities,␣
 ↪equal_var=False, alternative='greater')

print(f"T-statistic: {t_statistic}\nP-value: {p_value}")
alpha = 0.01
if p_value < alpha:
    print("%99,9 Kesinlikle Alternatif hipotezi kabul ediyoruz. Quito daki␣
 ↪ortalama mağaza satışları diğer şehirlerin toplamından daha yüksektir.")
else:
    print("Bu hipotez reddedilir. Quito'daki ortalama mağaza satışlarının daha␣
 ↪yüksek olduğuna dair yeterli kanıt yoktur.")
```

```
2442015.188611524
570950.2916061812
T-statistic: 180.58980305123487
P-value: 0.0
%99,9 Kesinlikle Alternatif hipotezi kabul ediyoruz. Quito daki ortalama mağaza
satışları diğer şehirlerin toplamından daha yüksektir.
```

1 Eğitim ve Test Verisinin Hazırlanması

```
[34]: train.corr(numeric_only=True)
```

```
[34]:                    id     store_nbr     sales  onpromotion       cluster  \
      id           1.000000  3.013308e-04  0.085784     0.206260 -4.369436e-05
      store_nbr    0.000301  1.000000e+00  0.041196     0.007286 -5.928399e-02
      sales        0.085784  4.119605e-02  1.000000     0.427923  3.852528e-02
      onpromotion  0.206260  7.285647e-03  0.427923     1.000000  5.666749e-03
      cluster     -0.000044 -5.928399e-02  0.038525     0.005667  1.000000e+00
      dcoilwtico  -0.838914  1.229619e-14 -0.078885    -0.152349 -3.586537e-14
      day         -0.001561  5.272840e-17  0.036869    -0.002696 -7.375769e-17
      month        0.067434 -4.946280e-15  0.019790     0.025881  3.843254e-15
      year         0.977603  8.754910e-15  0.081093     0.199060  4.952179e-14

                     dcoilwtico           day         month          year
      id          -8.389138e-01 -1.561462e-03  6.743357e-02  9.776028e-01
      store_nbr    1.229619e-14  5.272840e-17 -4.946280e-15  8.754910e-15
      sales       -7.888476e-02  3.686897e-02  1.978967e-02  8.109275e-02
      onpromotion -1.523492e-01 -2.696396e-03  2.588107e-02  1.990601e-01
      cluster     -3.586537e-14 -7.375769e-17  3.843254e-15  4.952179e-14
      dcoilwtico   1.000000e+00  3.637119e-03  7.035660e-03 -8.342069e-01
      day          3.637119e-03  1.000000e+00 -5.607083e-03 -3.993864e-04
      month        7.035660e-03 -5.607083e-03  1.000000e+00 -1.432929e-01
      year        -8.342069e-01 -3.993864e-04 -1.432929e-01  1.000000e+00
```

```
[35]: train.describe()
```

[35]:
```
                 id                           date      store_nbr  \
count  3.000888e+06                        3000888   3.000888e+06
mean   1.500444e+06  2015-04-24 08:27:04.703088384   2.750000e+01
min    0.000000e+00            2013-01-01 00:00:00   1.000000e+00
25%    7.502218e+05            2014-02-26 18:00:00   1.400000e+01
50%    1.500444e+06            2015-04-24 12:00:00   2.750000e+01
75%    2.250665e+06            2016-06-19 06:00:00   4.100000e+01
max    3.000887e+06            2017-08-15 00:00:00   5.400000e+01
std    8.662819e+05                            NaN   1.558579e+01

              sales   onpromotion       cluster    dcoilwtico           day  \
count  3.000888e+06  3.000888e+06  3.000888e+06  2.143746e+06  3.000888e+06
mean   3.577757e+02  2.602770e+00  8.481481e+00  6.789904e+01  2.997031e+00
min    0.000000e+00  0.000000e+00  1.000000e+00  2.619000e+01  0.000000e+00
25%    0.000000e+00  0.000000e+00  4.000000e+00  4.640000e+01  1.000000e+00
50%    1.100000e+01  0.000000e+00  8.500000e+00  5.338000e+01  3.000000e+00
75%    1.958473e+02  0.000000e+00  1.300000e+01  9.580000e+01  5.000000e+00
max    1.247170e+05  7.410000e+02  1.700000e+01  1.106200e+02  6.000000e+00
std    1.101998e+03  1.221888e+01  4.649735e+00  2.566586e+01  2.000740e+00

              month          year
count  3.000888e+06  3.000888e+06
mean   6.207838e+00  2.014838e+03
min    1.000000e+00  2.013000e+03
25%    3.000000e+00  2.014000e+03
50%    6.000000e+00  2.015000e+03
75%    9.000000e+00  2.016000e+03
max    1.200000e+01  2.017000e+03
std    3.385668e+00  1.345518e+00
```

[36]:
```
train.describe(include=['O'])
```

[36]:
```
            family   type_x    locale locale_name description transferred  \
count      3000888   449064    449064      449064      449064      449064
unique          33        6         3          22          97           2
top     AUTOMOTIVE  Holiday  National     Ecuador    Carnaval       False
freq         90936   263736    249480      249480       17820      433026

           city      state   type_y
count   3000888    3000888  3000888
unique       22         16        5
top       Quito  Pichincha        D
freq    1000296    1055868  1000296
```

[37]:
```
train.head(10)
```

[37]:

```
   id       date  store_nbr        family  sales  onpromotion   type_x  \
0   0 2013-01-01          1    AUTOMOTIVE    0.0            0  Holiday
1   1 2013-01-01          1     BABY CARE    0.0            0  Holiday
2   2 2013-01-01          1        BEAUTY    0.0            0  Holiday
3   3 2013-01-01          1     BEVERAGES    0.0            0  Holiday
4   4 2013-01-01          1         BOOKS    0.0            0  Holiday
5   5 2013-01-01          1  BREAD/BAKERY    0.0            0  Holiday
6   6 2013-01-01          1   CELEBRATION    0.0            0  Holiday
7   7 2013-01-01          1      CLEANING    0.0            0  Holiday
8   8 2013-01-01          1         DAIRY    0.0            0  Holiday
9   9 2013-01-01          1          DELI    0.0            0  Holiday

     locale locale_name         description transferred   city      state  \
0  National     Ecuador  Primer dia del ano       False  Quito  Pichincha
1  National     Ecuador  Primer dia del ano       False  Quito  Pichincha
2  National     Ecuador  Primer dia del ano       False  Quito  Pichincha
3  National     Ecuador  Primer dia del ano       False  Quito  Pichincha
4  National     Ecuador  Primer dia del ano       False  Quito  Pichincha
5  National     Ecuador  Primer dia del ano       False  Quito  Pichincha
6  National     Ecuador  Primer dia del ano       False  Quito  Pichincha
7  National     Ecuador  Primer dia del ano       False  Quito  Pichincha
8  National     Ecuador  Primer dia del ano       False  Quito  Pichincha
9  National     Ecuador  Primer dia del ano       False  Quito  Pichincha

  type_y  cluster  dcoilwtico  day  month  year
0      D       13       93.14    1      1  2013
1      D       13       93.14    1      1  2013
2      D       13       93.14    1      1  2013
3      D       13       93.14    1      1  2013
4      D       13       93.14    1      1  2013
5      D       13       93.14    1      1  2013
6      D       13       93.14    1      1  2013
7      D       13       93.14    1      1  2013
8      D       13       93.14    1      1  2013
9      D       13       93.14    1      1  2013
```

[38]:

```python
train.drop("transferred",axis=1,inplace=True)
train.drop("date",axis=1,inplace=True)
train.drop("id",axis=1,inplace=True)
train.drop("description",axis=1,inplace=True)
train.drop("type_x",axis=1,inplace=True)
train.drop("locale",axis=1,inplace=True)
train.drop("city",axis=1,inplace=True)
train.drop("state",axis=1,inplace=True)
train.drop("type_y",axis=1,inplace=True)
train.drop("cluster",axis=1,inplace=True)
```

```
[39]: train.isnull().sum()
```

```
[39]: store_nbr            0
      family               0
      sales                0
      onpromotion          0
      locale_name    2551824
      dcoilwtico      857142
      day                  0
      month                0
      year                 0
      dtype: int64
```

```
[40]: train.dcoilwtico = train.dcoilwtico.interpolate(method="polynomial", order=2,␣
        ↪limit_direction="both")
```

```
[41]: train_data=pd.
        ↪get_dummies(data=train,columns=["store_nbr","family","locale_name"],dtype=int)
```

```
[42]: train_data.head()
```

```
[42]:    sales  onpromotion  dcoilwtico  day  month  year  store_nbr_1  store_nbr_2  \
      0    0.0            0       93.14    1      1  2013            1            0
      1    0.0            0       93.14    1      1  2013            1            0
      2    0.0            0       93.14    1      1  2013            1            0
      3    0.0            0       93.14    1      1  2013            1            0
      4    0.0            0       93.14    1      1  2013            1            0

         store_nbr_3  store_nbr_4  …  locale_name_Machala  locale_name_Manta  \
      0            0            0  …                    0                  0
      1            0            0  …                    0                  0
      2            0            0  …                    0                  0
      3            0            0  …                    0                  0
      4            0            0  …                    0                  0

         locale_name_Puyo  locale_name_Quevedo  locale_name_Quito  \
      0                 0                    0                  0
      1                 0                    0                  0
      2                 0                    0                  0
      3                 0                    0                  0
      4                 0                    0                  0

         locale_name_Riobamba  locale_name_Salinas  locale_name_Santa Elena  \
      0                     0                    0                        0
      1                     0                    0                        0
      2                     0                    0                        0
      3                     0                    0                        0
```

```
4                     0                    0                         0

   locale_name_Santo Domingo  locale_name_Santo Domingo de los Tsachilas
0                          0                                           0
1                          0                                           0
2                          0                                           0
3                          0                                           0
4                          0                                           0

[5 rows x 115 columns]
```

[43]:

```
y=train_data["sales"]
train_data.drop(["sales"],axis=1,inplace=True)
```

[44]:

```
x_train=train_data.iloc[0:2400355,:].values
y_train=y[0:2400355].values
x_test=train_data.iloc[2400355:,:].values
y_test=y[2400355:].values
```

[45]:

```
from sklearn.preprocessing import MinMaxScaler
mms=MinMaxScaler()
x_train=mms.fit_transform(x_train)
x_test=mms.transform(x_test)
```

2 Xgboost

[46]:

```
import xgboost as xgb
from xgboost import XGBRegressor

xgbr=XGBRegressor(n_estimators=495, random_state=0, learning_rate=0.01)
xgbr.fit(x_train, y_train)
```

[46]:

```
XGBRegressor(base_score=None, booster=None, callbacks=None,
             colsample_bylevel=None, colsample_bynode=None,
             colsample_bytree=None, early_stopping_rounds=None,
             enable_categorical=False, eval_metric=None, feature_types=None,
             gamma=None, gpu_id=None, grow_policy=None, importance_type=None,
             interaction_constraints=None, learning_rate=0.01, max_bin=None,
             max_cat_threshold=None, max_cat_to_onehot=None,
             max_delta_step=None, max_depth=None, max_leaves=None,
             min_child_weight=None, missing=nan, monotone_constraints=None,
             n_estimators=495, n_jobs=None, num_parallel_tree=None,
             predictor=None, random_state=0, …)
```

[47]:

```
y_pred=xgbr.predict(x_test)
```

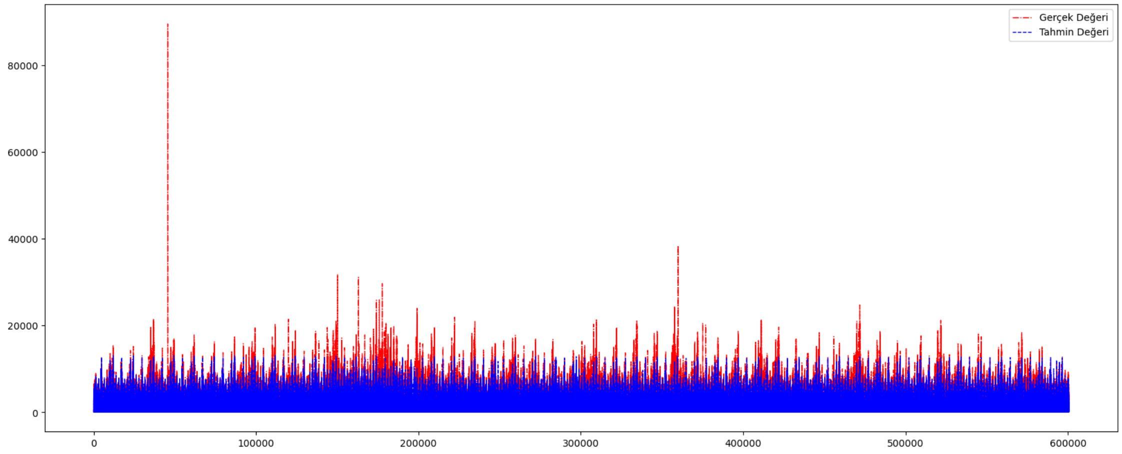
[48]:

```
from sklearn.metrics import␣
 ↪r2_score,mean_absolute_error,mean_squared_error,mean_squared_log_error
print("r2 score: ",r2_score(y_test,y_pred),
      "\nMAE: ",mean_absolute_error(y_test,y_pred),
      "\nMSE: ",mean_squared_error(y_test,y_pred),
      "\nRMSLE: ",mean_squared_log_error(y_test,y_pred,squared=False))
```

```
r2 score:  0.8318315362231672
MAE:  216.26928684870023
MSE:  311565.2252943518
RMSLE:  2.0131724221171625
```

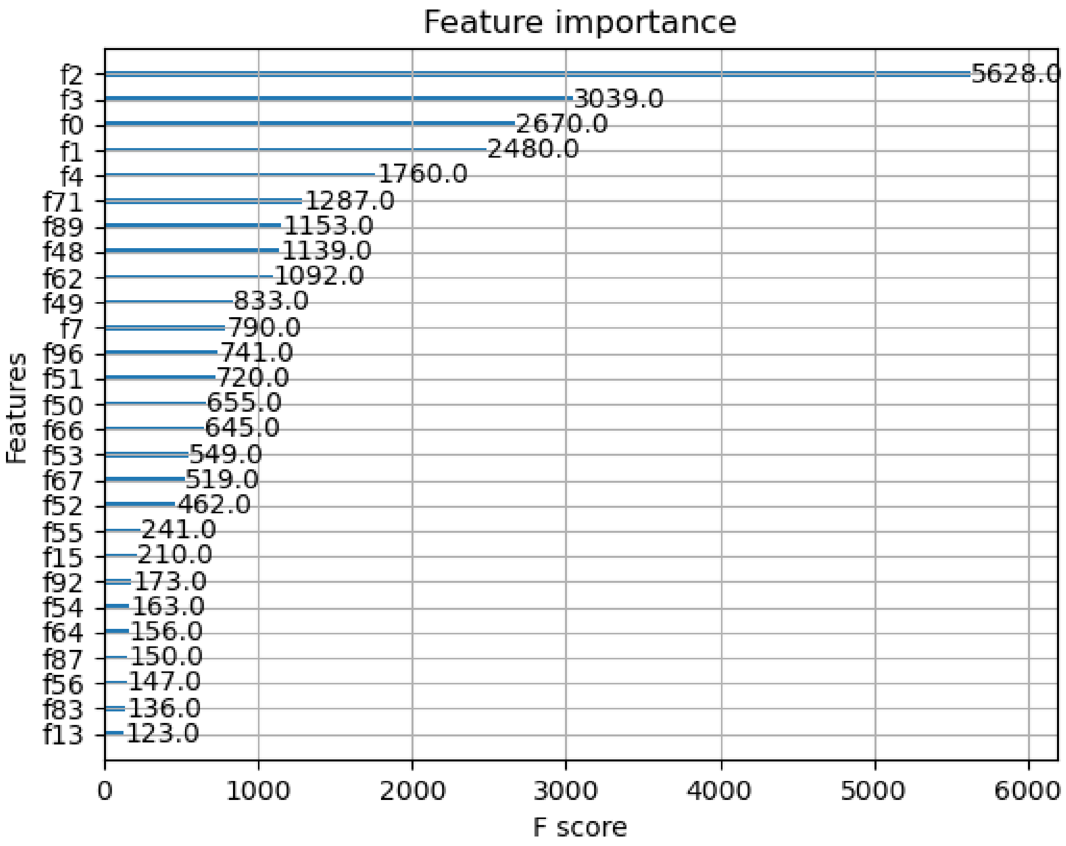
[49]:

```
x=np.arange(len(y_test))
fig, ax=plt.subplots(figsize=(20,8),dpi=100)
ax.plot(x,y_test,color="red",linestyle="-.",label="Gerçek Değeri",linewidth=1)
ax.plot(x,y_pred,color="blue",linestyle="--",label="Tahmin Değeri",linewidth=1)
ax.legend()
plt.show()
```



[50]:

```
from xgboost import plot_importance
importance=plot_importance(xgbr,max_num_features = 27)
```



```
[51]: print("İlk Beş Değişken:\nf2 => day\nf3 => month\nf0 => onpromotoin\nf1 =>␣
        ↪dcoilwtico\nf4 => year")
```

```
İlk Beş Değişken:
f2 => day
f3 => month
f0 => onpromotoin
f1 => dcoilwtico
f4 => year
```

```
[ ]:
```