Product Sales Analysis

Importing required libraries

In [14]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

In [ ]:
```
```

In [15]:
```
!pip install wordcloud
```

```
Requirement already satisfied: wordcloud in c:\users\sanjay pk\anaconda3\lib\site-
packages (1.9.2)
Requirement already satisfied: matplotlib in c:\users\sanjay pk\anaconda3\lib\site
-packages (from wordcloud) (3.5.2)
Requirement already satisfied: pillow in c:\users\sanjay pk\anaconda3\lib\site-pac
kages (from wordcloud) (9.2.0)
Requirement already satisfied: numpy>=1.6.1 in c:\users\sanjay pk\anaconda3\lib\si
te-packages (from wordcloud) (1.21.5)
Requirement already satisfied: fonttools>=4.22.0 in c:\users\sanjay pk\anaconda3\l
ib\site-packages (from matplotlib->wordcloud) (4.25.0)
Requirement already satisfied: packaging>=20.0 in c:\users\sanjay pk\anaconda3\lib
\site-packages (from matplotlib->wordcloud) (21.3)
Requirement already satisfied: cycler>=0.10 in c:\users\sanjay pk\anaconda3\lib\si
te-packages (from matplotlib->wordcloud) (0.11.0)
Requirement already satisfied: kiwisolver>=1.0.1 in c:\users\sanjay pk\anaconda3\l
ib\site-packages (from matplotlib->wordcloud) (1.4.2)
Requirement already satisfied: pyparsing>=2.2.1 in c:\users\sanjay pk\anaconda3\li
b\site-packages (from matplotlib->wordcloud) (3.0.9)
Requirement already satisfied: python-dateutil>=2.7 in c:\users\sanjay pk\anaconda
3\lib\site-packages (from matplotlib->wordcloud) (2.8.2)
Requirement already satisfied: six>=1.5 in c:\users\sanjay pk\anaconda3\lib\site-p
ackages (from python-dateutil>=2.7->matplotlib->wordcloud) (1.16.0)
```

In [16]:
```
import os
from wordcloud import WordCloud
%matplotlib inline
import warnings
warnings.filterwarnings("ignore")
```

Importing the Dataset

In [17]:
```
data = pd.read_csv('Documents/statsfinal.csv')
data
```

Out[17]:

	Unnamed: 0	Date	Q-P1	Q-P2	Q-P3	Q-P4	S-P1	S-P2	S-P3	S-P4
0	0	13-06-2010	5422	3725	576	907	17187.74	23616.50	3121.92	6466.91
1	1	14-06-2010	7047	779	3578	1574	22338.99	4938.86	19392.76	11222.62
2	2	15-06-2010	1572	2082	595	1145	4983.24	13199.88	3224.90	8163.85
3	3	16-06-2010	5657	2399	3140	1672	17932.69	15209.66	17018.80	11921.36
4	4	17-06-2010	3668	3207	2184	708	11627.56	20332.38	11837.28	5048.04
...	...	...	...	...	...	...	...	...	...	...
4595	4595	30-01-2023	2476	3419	525	1359	7848.92	21676.46	2845.50	9689.67
4596	4596	31-01-2023	7446	841	4825	1311	23603.82	5331.94	26151.50	9347.43
4597	4597	01-02-2023	6289	3143	3588	474	19936.13	19926.62	19446.96	3379.62
4598	4598	02-02-2023	3122	1188	5899	517	9896.74	7531.92	31972.58	3686.21
4599	4599	03-02-2023	1234	3854	2321	406	3911.78	24434.36	12579.82	2894.78

4600 rows × 10 columns

Droping the columns

In [18]:
```
data = data.drop(columns=['Unnamed: 0'])
data
```

Out[18]:

	Date	Q-P1	Q-P2	Q-P3	Q-P4	S-P1	S-P2	S-P3	S-P4
0	13-06-2010	5422	3725	576	907	17187.74	23616.50	3121.92	6466.91
1	14-06-2010	7047	779	3578	1574	22338.99	4938.86	19392.76	11222.62
2	15-06-2010	1572	2082	595	1145	4983.24	13199.88	3224.90	8163.85
3	16-06-2010	5657	2399	3140	1672	17932.69	15209.66	17018.80	11921.36
4	17-06-2010	3668	3207	2184	708	11627.56	20332.38	11837.28	5048.04
...	...	...	...	...	...	...	...	...	...
4595	30-01-2023	2476	3419	525	1359	7848.92	21676.46	2845.50	9689.67
4596	31-01-2023	7446	841	4825	1311	23603.82	5331.94	26151.50	9347.43
4597	01-02-2023	6289	3143	3588	474	19936.13	19926.62	19446.96	3379.62
4598	02-02-2023	3122	1188	5899	517	9896.74	7531.92	31972.58	3686.21
4599	03-02-2023	1234	3854	2321	406	3911.78	24434.36	12579.82	2894.78

4600 rows × 9 columns

Checking the dataset

In [20]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4600 entries, 0 to 4599
Data columns (total 9 columns):
 #   Column  Non-Null Count  Dtype  
---  ------  --------------  -----  
 0   Date    4600 non-null   object 
 1   Q-P1    4600 non-null   int64  
 2   Q-P2    4600 non-null   int64  
 3   Q-P3    4600 non-null   int64  
 4   Q-P4    4600 non-null   int64  
 5   S-P1    4600 non-null   float64
 6   S-P2    4600 non-null   float64
 7   S-P3    4600 non-null   float64
 8   S-P4    4600 non-null   float64
dtypes: float64(4), int64(4), object(1)
memory usage: 323.6+ KB
```

Checking the missing values

In [22]:
```
data.isnull().sum()
```

Out[22]:

```
Date    0
Q-P1    0
Q-P2    0
Q-P3    0
Q-P4    0
S-P1    0
S-P2    0
S-P3    0
S-P4    0
dtype: int64
```

In [23]:
```
data['Day'] = data['Date'].apply(lambda x: x.split('-')[0])
data['Month'] = data['Date'].apply(lambda x: x.split('-')[1])
data['Year'] = data['Date'].apply(lambda x: x.split('-')[2])
data
```

Out[23]:

	Date	Q-P1	Q-P2	Q-P3	Q-P4	S-P1	S-P2	S-P3	S-P4	Day	Month	Year
0	13-06-2010	5422	3725	576	907	17187.74	23616.50	3121.92	6466.91	13	06	2010
1	14-06-2010	7047	779	3578	1574	22338.99	4938.86	19392.76	11222.62	14	06	2010
2	15-06-2010	1572	2082	595	1145	4983.24	13199.88	3224.90	8163.85	15	06	2010
3	16-06-2010	5657	2399	3140	1672	17932.69	15209.66	17018.80	11921.36	16	06	2010
4	17-06-2010	3668	3207	2184	708	11627.56	20332.38	11837.28	5048.04	17	06	2010
...	...	...	...	...	...	...	...	...	...	...	...	...
4595	30-01-2023	2476	3419	525	1359	7848.92	21676.46	2845.50	9689.67	30	01	2023
4596	31-01-2023	7446	841	4825	1311	23603.82	5331.94	26151.50	9347.43	31	01	2023
4597	01-02-2023	6289	3143	3588	474	19936.13	19926.62	19446.96	3379.62	01	02	2023
4598	02-02-2023	3122	1188	5899	517	9896.74	7531.92	31972.58	3686.21	02	02	2023
4599	03-02-2023	1234	3854	2321	406	3911.78	24434.36	12579.82	2894.78	03	02	2023

4600 rows × 12 columns

Visualizing the data's from 2010 to 2023

In [25]:
```
data_reduced = data.query("Year != '2010' and Year != '2023'")
data
```

Out[25]:

	Date	Q-P1	Q-P2	Q-P3	Q-P4	S-P1	S-P2	S-P3	S-P4	Day	Month	Year
0	13-06-2010	5422	3725	576	907	17187.74	23616.50	3121.92	6466.91	13	06	2010
1	14-06-2010	7047	779	3578	1574	22338.99	4938.86	19392.76	11222.62	14	06	2010
2	15-06-2010	1572	2082	595	1145	4983.24	13199.88	3224.90	8163.85	15	06	2010
3	16-06-2010	5657	2399	3140	1672	17932.69	15209.66	17018.80	11921.36	16	06	2010
4	17-06-2010	3668	3207	2184	708	11627.56	20332.38	11837.28	5048.04	17	06	2010
...	...	...	...	...	...	...	...	...	...	...	...	...
4595	30-01-2023	2476	3419	525	1359	7848.92	21676.46	2845.50	9689.67	30	01	2023
4596	31-01-2023	7446	841	4825	1311	23603.82	5331.94	26151.50	9347.43	31	01	2023
4597	01-02-2023	6289	3143	3588	474	19936.13	19926.62	19446.96	3379.62	01	02	2023
4598	02-02-2023	3122	1188	5899	517	9896.74	7531.92	31972.58	3686.21	02	02	2023
4599	03-02-2023	1234	3854	2321	406	3911.78	24434.36	12579.82	2894.78	03	02	2023

4600 rows × 12 columns

In [17]:
```
data['Date'] = pd.to_datetime(data['Date'], errors='coerce')
data
```

Out[17]:

	Date	Q-P1	Q-P2	Q-P3	Q-P4	S-P1	S-P2	S-P3	S-P4	Day	Month	Year
0	2010-06-13	5422	3725	576	907	17187.74	23616.50	3121.92	6466.91	13	06	2010
1	2010-06-14	7047	779	3578	1574	22338.99	4938.86	19392.76	11222.62	14	06	2010
2	2010-06-15	1572	2082	595	1145	4983.24	13199.88	3224.90	8163.85	15	06	2010
3	2010-06-16	5657	2399	3140	1672	17932.69	15209.66	17018.80	11921.36	16	06	2010
4	2010-06-17	3668	3207	2184	708	11627.56	20332.38	11837.28	5048.04	17	06	2010
...	...	...	...	...	...	...	...	...	...	...	...	...
4595	2023-01-30	2476	3419	525	1359	7848.92	21676.46	2845.50	9689.67	30	01	2023
4596	2023-01-31	7446	841	4825	1311	23603.82	5331.94	26151.50	9347.43	31	01	2023
4597	2023-01-02	6289	3143	3588	474	19936.13	19926.62	19446.96	3379.62	01	02	2023
4598	2023-02-02	3122	1188	5899	517	9896.74	7531.92	31972.58	3686.21	02	02	2023
4599	2023-03-02	1234	3854	2321	406	3911.78	24434.36	12579.82	2894.78	03	02	2023

4600 rows × 12 columns

In [18]:
```
from datetime import datetime as dt
data[data["Date"]=="31-9-2010"]
data["Date"]
```

Out[18]:
```
0       2010-06-13
1       2010-06-14
2       2010-06-15
3       2010-06-16
4       2010-06-17
           ...
4595    2023-01-30
4596    2023-01-31
4597    2023-01-02
4598    2023-02-02
4599    2023-03-02
Name: Date, Length: 4600, dtype: datetime64[ns]
```

In [58]:
```
data['Date'] = pd.to_datetime(data['Date'], errors='coerce')
```

In [59]:
```
data["Date"].fillna(data["Date"].mean(),inplace=True)
```

In [60]:
```
data[data['Date'].isnull()]
data['Date']
```

Out[60]:
```
0       2010-06-13
1       2010-06-14
2       2010-06-15
3       2010-06-16
4       2010-06-17
           ...
4595    2023-01-30
4596    2023-01-31
4597    2023-01-02
4598    2023-02-02
4599    2023-03-02
Name: Date, Length: 4600, dtype: datetime64[ns]
```

In [61]:
```
data["month"]=data["Date"].dt.month_name()
data["day"]=data["Date"].dt.day_name()
data["dayoftheweek"]=data["Date"].dt.weekday
data["year"]=data["Date"].dt.year
data.sample()
```

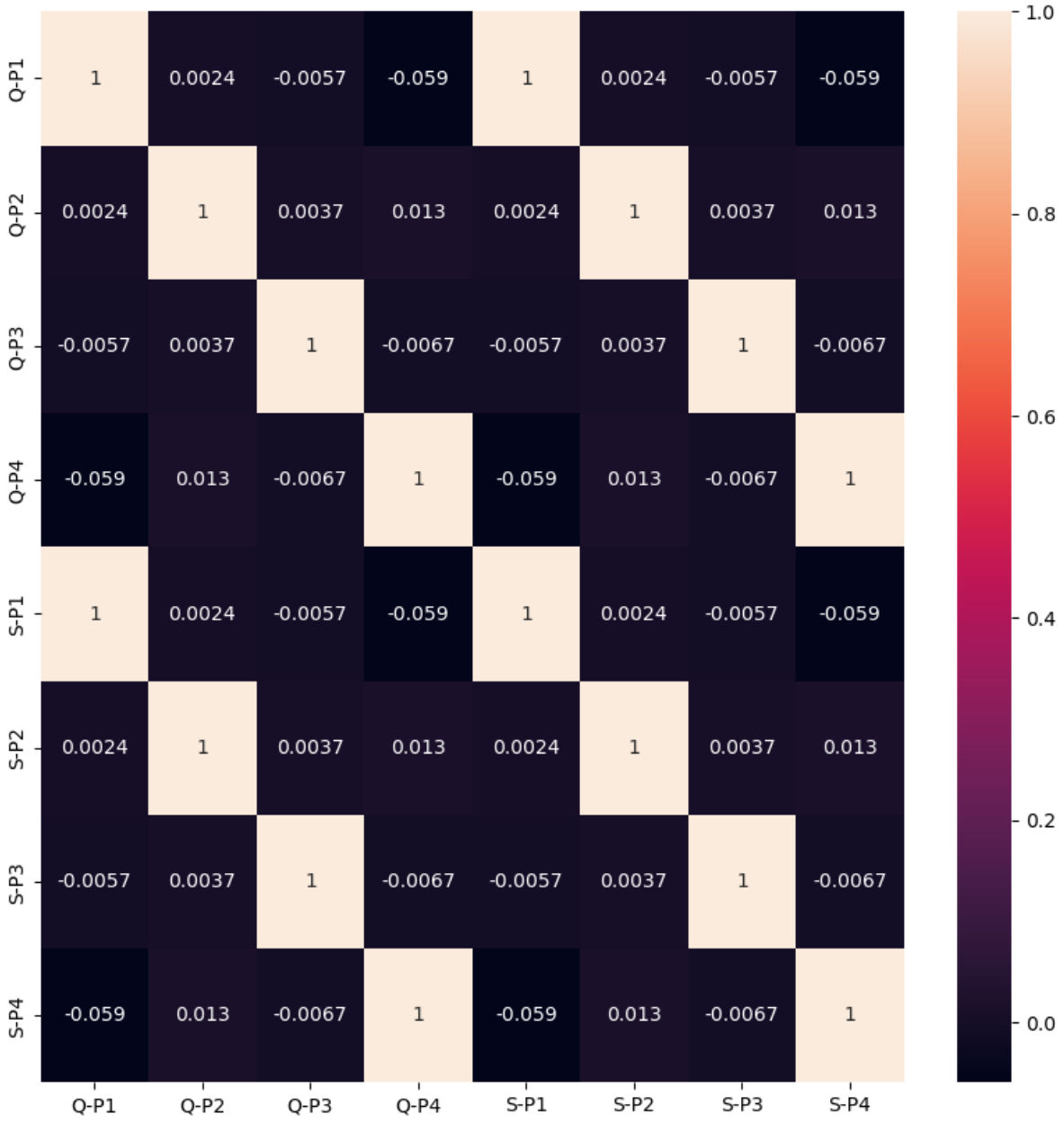
Out[61]:

	Date	Q-P1	Q-P2	Q-P3	Q-P4	S-P1	S-P2	S-P3	S-P4	Day	Month	Year	m
710	2012-05-27	1401	1609	1961	1897	4441.17	10201.06	10628.62	13525.61	27	05	2012	

Visualizing the Datasets using various Graphs

In [20]:
```
plt.figure(figsize=(10,10))
sns.heatmap(data.corr(),annot=True)
```

Out[20]:
```
<AxesSubplot:>
```



In [21]:
```
data.corr().T
```

Out[21]:

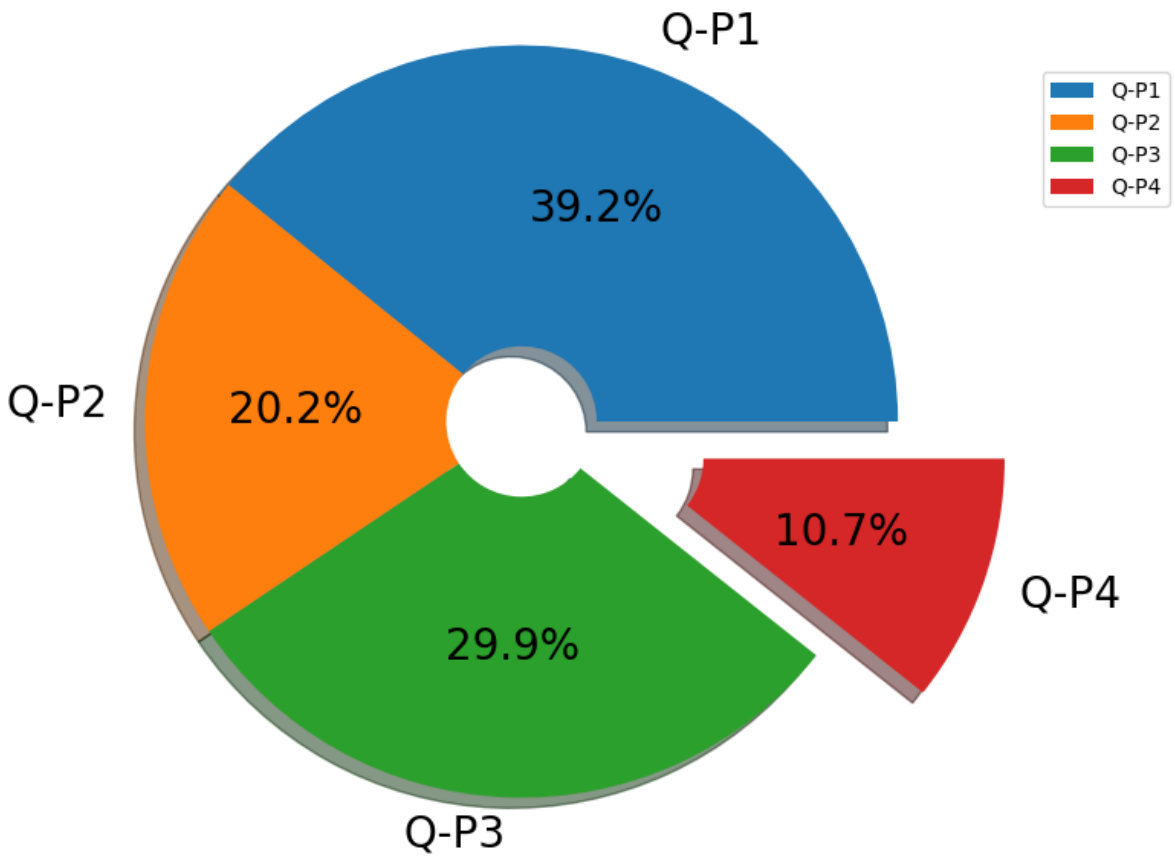
	Q-P1	Q-P2	Q-P3	Q-P4	S-P1	S-P2	S-P3	S-P4
Q-P1	1.000000	0.002422	-0.005650	-0.059365	1.000000	0.002422	-0.005650	-0.059365
Q-P2	0.002422	1.000000	0.003729	0.013082	0.002422	1.000000	0.003729	0.013082
Q-P3	-0.005650	0.003729	1.000000	-0.006693	-0.005650	0.003729	1.000000	-0.006693
Q-P4	-0.059365	0.013082	-0.006693	1.000000	-0.059365	0.013082	-0.006693	1.000000
S-P1	1.000000	0.002422	-0.005650	-0.059365	1.000000	0.002422	-0.005650	-0.059365
S-P2	0.002422	1.000000	0.003729	0.013082	0.002422	1.000000	0.003729	0.013082
S-P3	-0.005650	0.003729	1.000000	-0.006693	-0.005650	0.003729	1.000000	-0.006693
S-P4	-0.059365	0.013082	-0.006693	1.000000	-0.059365	0.013082	-0.006693	1.000000

In [22]:
```
for i in data.columns:
    print(i,"---------",data[i].unique())
```

```
Date --------- ['2010-06-13T00:00:00.000000000' '2010-06-14T00:00:00.000000000'
 '2010-06-15T00:00:00.000000000' ... '2023-01-02T00:00:00.000000000'
 '2023-02-02T00:00:00.000000000' '2023-03-02T00:00:00.000000000']
Q-P1 --------- [5422 7047 1572 ... 1227 3122 1234]
Q-P2 --------- [3725  779 2082 ... 3404  841 3143]
Q-P3 --------- [ 576 3578  595 ... 4825 3588 5899]
Q-P4 --------- [ 907 1574 1145 ... 1161 1151 1112]
S-P1 --------- [17187.74 22338.99  4983.24 ...  3889.59  9896.74  3911.78]
S-P2 --------- [23616.5   4938.86 13199.88 ... 21581.36  5331.94 19926.62]
S-P3 --------- [ 3121.92 19392.76  3224.9  ... 26151.5  19446.96 31972.58]
S-P4 --------- [ 6466.91 11222.62  8163.85 ...  8277.93  8206.63  7928.56]
Day --------- ['13' '14' '15' '16' '17' '18' '19' '20' '21' '22' '23' '24' '25' '2
6'
 '27' '28' '29' '30' '01' '02' '03' '04' '05' '06' '07' '08' '09' '10'
 '11' '12' '31']
Month --------- ['06' '07' '08' '09' '9' '10' '11' '12' '01' '02' '03' '04' '05']
Year --------- ['2010' '2011' '2012' '2013' '2014' '2015' '2016' '2017' '2018' '20
19'
 '2020' '2021' '2022' '2023']
```

In [23]:
```
q = data[["Q-P1","Q-P2","Q-P3","Q-P4"]].sum()
print(q)
plt.figure(figsize=(8,8))
plt.pie(q,labels=data[["Q-P1","Q-P2","Q-P3","Q-P4"]].sum().index,shadow=True,autopc
plt.legend(loc='center right', bbox_to_anchor=(1.2, 0.8));
```

```
Q-P1    18960506
Q-P2     9799295
Q-P3    14470404
Q-P4     5168100
dtype: int64
```

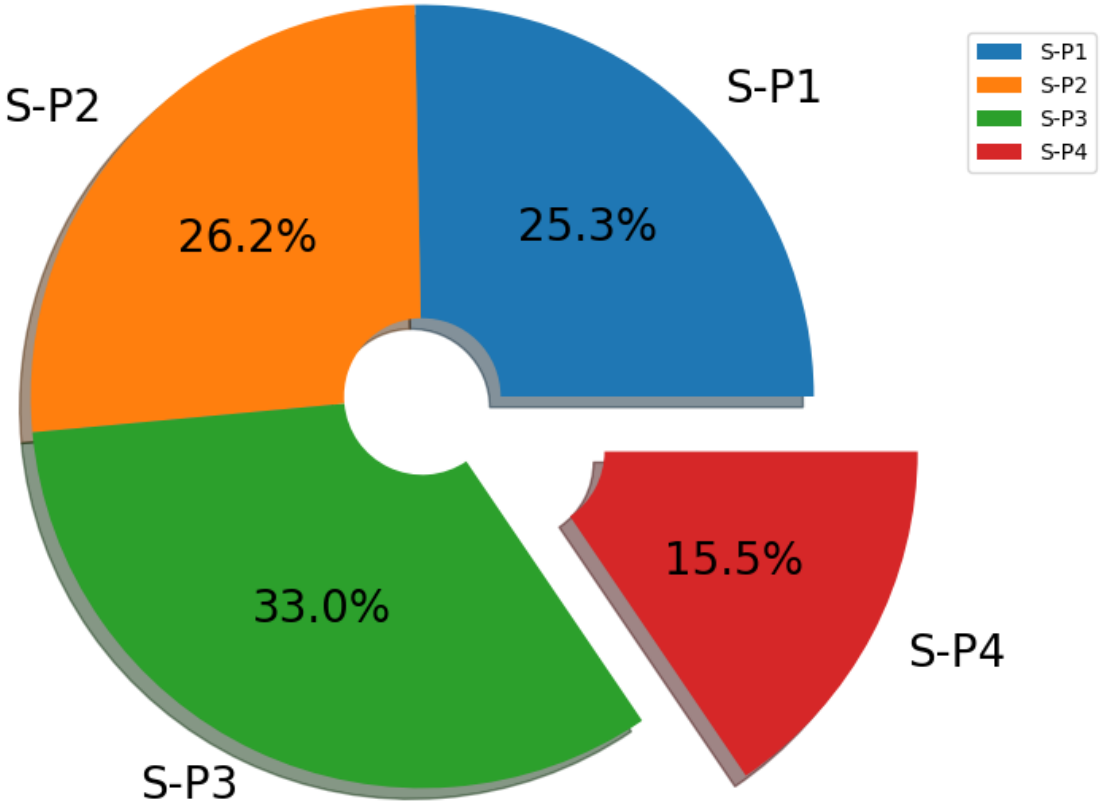


In [24]:
```
s=data[["S-P1","S-P2","S-P3","S-P4"]].sum()
print(s)
```

```
plt.figure(figsize=(8,8))
plt.pie(s,labels=data[["S-P1","S-P2","S-P3","S-P4"]].sum().index,shadow=True,autopc
plt.legend(loc='center right', bbox_to_anchor=(1.2, 0.8))
```

```
S-P1    60104804.02
S-P2    62127530.30
S-P3    78429589.68
S-P4    36848553.00
dtype: float64
```

Out[24]: <matplotlib.legend.Legend at 0x1d721073790>



In [25]:
```
data.groupby ("Year")[["Q-P1","Q-P2","Q-P3","Q-P4"]].sum()
```

Out[25]:

Year	Q-P1	Q-P2	Q-P3	Q-P4
2010	811971	433310	630125	221988
2011	1435633	751692	1160897	412322
2012	1508611	769797	1144590	417920
2013	1533099	754526	1116114	405394
2014	1572144	789069	1162719	403748
2015	1484197	767964	1112136	413251
2016	1517603	783892	1112698	408415
2017	1469715	808843	1166668	419020
2018	1531419	751252	1152070	398550
2019	1482623	785373	1135262	410425
2020	1498357	778322	1175277	419854
2021	1504995	786444	1166733	407373
2022	1459829	760510	1115085	389915
2023	150310	78301	120030	39925

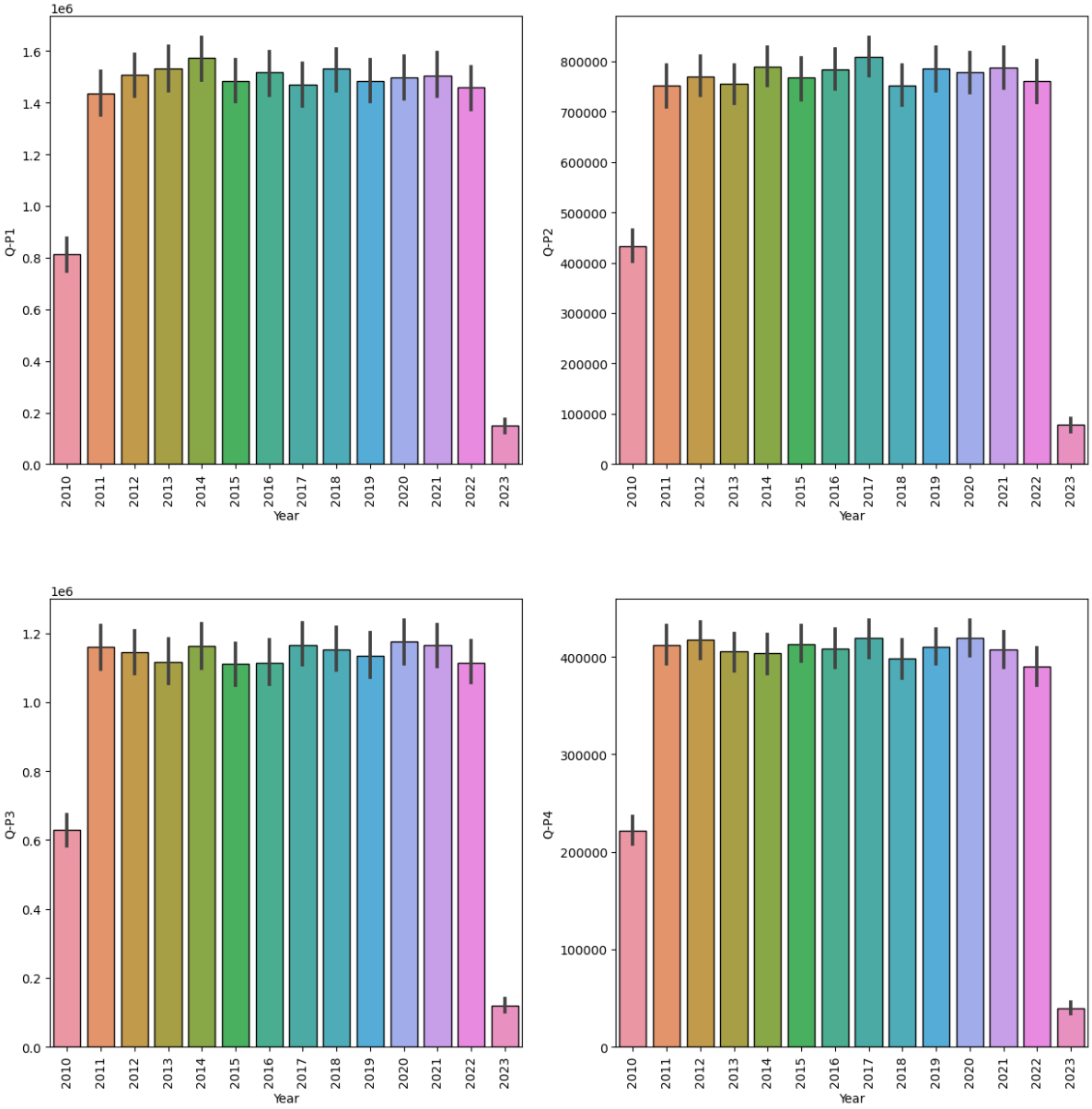
In [62]:
```
data.groupby ("month")[["Q-P1","Q-P2","Q-P3","Q-P4"]].sum()
```

Out[62]:

month	Q-P1	Q-P2	Q-P3	Q-P4
April	1575469	800379	1147329	416638
August	1587520	840265	1207606	428962
December	1621585	823098	1191402	435175
February	1443764	719534	1114785	366542
January	1592433	845579	1234912	452832
July	1642160	820048	1242157	440686
June	1656731	824354	1213026	440737
March	1509817	841015	1188338	434589
May	1572199	821412	1240223	421638
November	1518591	807424	1200826	444350
October	1720772	863143	1262142	451772
September	1519465	793044	1227658	434179

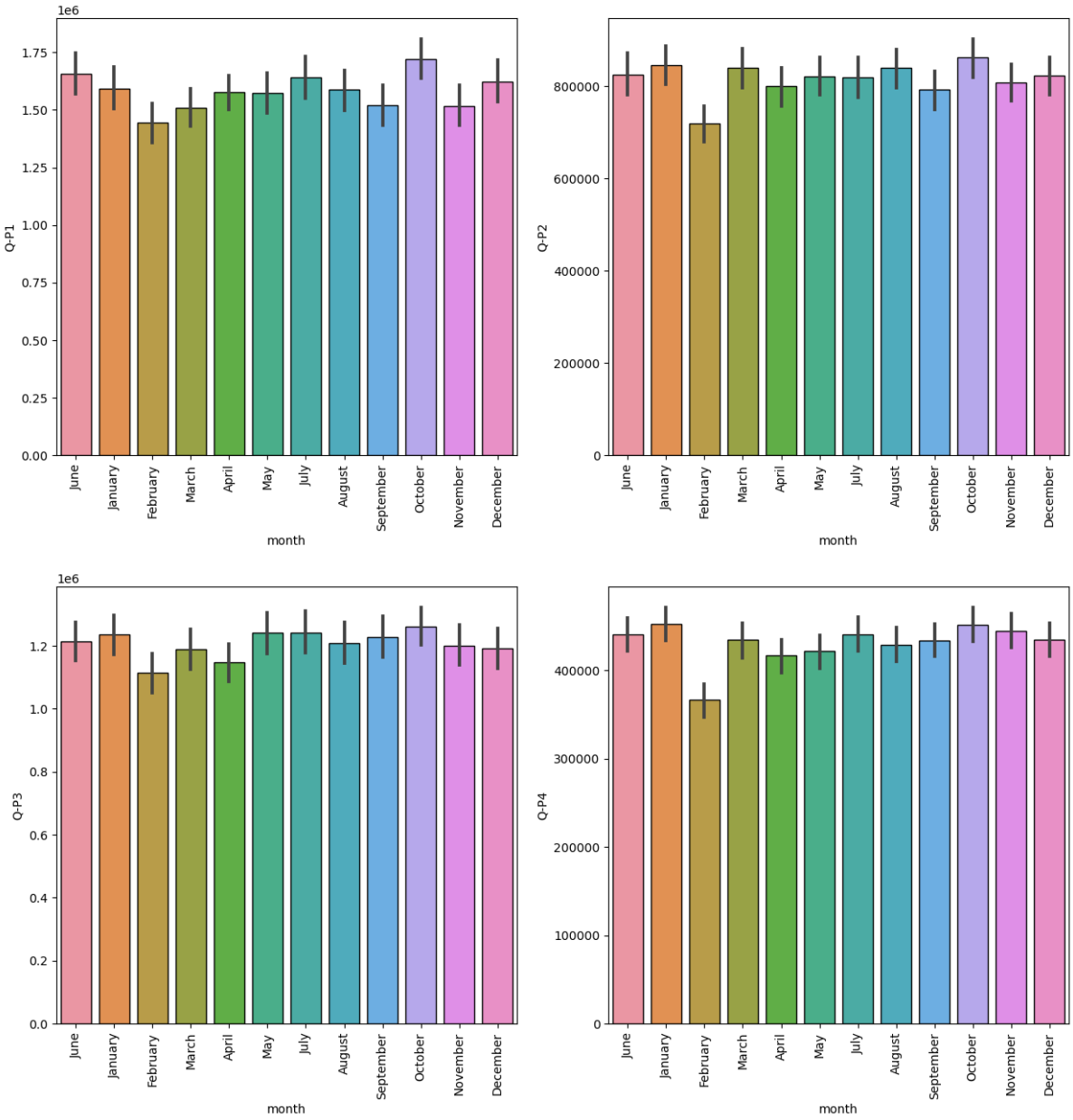
In [26]:
```
plt.figure(figsize=(15,15),dpi=100)
plt.subplot(2,2,1)
sns.barplot(x="Year",y="Q-P1",data=data,edgecolor="black",estimator=sum)
plt.xticks(rotation=90);
plt.subplot(2,2,2)
sns.barplot(x="Year",y="Q-P2",data=data,edgecolor="black",estimator=sum)
plt.xticks(rotation=90);
```

```
plt.subplot(2,2,3)
sns.barplot(x="Year",y="Q-P3",data=data,edgecolor="black",estimator=sum)
plt.xticks(rotation=90);
plt.subplot(2,2,4)
sns.barplot(x="Year",y="Q-P4",data=data,edgecolor="black",estimator=sum)
plt.xticks(rotation=90)
plt.subplots_adjust(hspace=0.3);
```



In [63]:

```
plt.figure(figsize=(15,15),dpi=100)
plt.subplot(2,2,1)
sns.barplot(x="month",y="Q-P1",data=data,edgecolor="black",estimator=sum)
plt.xticks(rotation=90);
plt.subplot(2,2,2)
sns.barplot(x="month",y="Q-P2",data=data,edgecolor="black",estimator=sum)
plt.xticks(rotation=90);
plt.subplot(2,2,3)
sns.barplot(x="month",y="Q-P3",data=data,edgecolor="black",estimator=sum)
plt.xticks(rotation=90);
plt.subplot(2,2,4)
sns.barplot(x="month",y="Q-P4",data=data,edgecolor="black",estimator=sum)
plt.xticks(rotation=90)
plt.subplots_adjust(hspace=0.3);
```

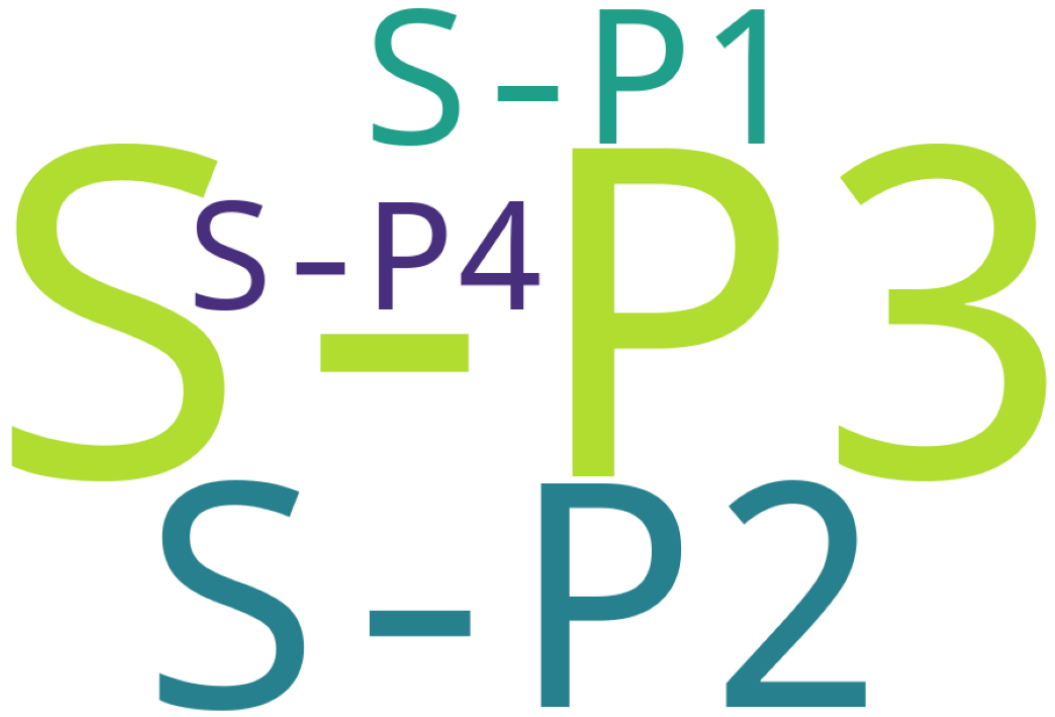


In [27]:
```
data[["S-P1","S-P2","S-P3","S-P4"]].agg(["sum","max","min","mean"])
```

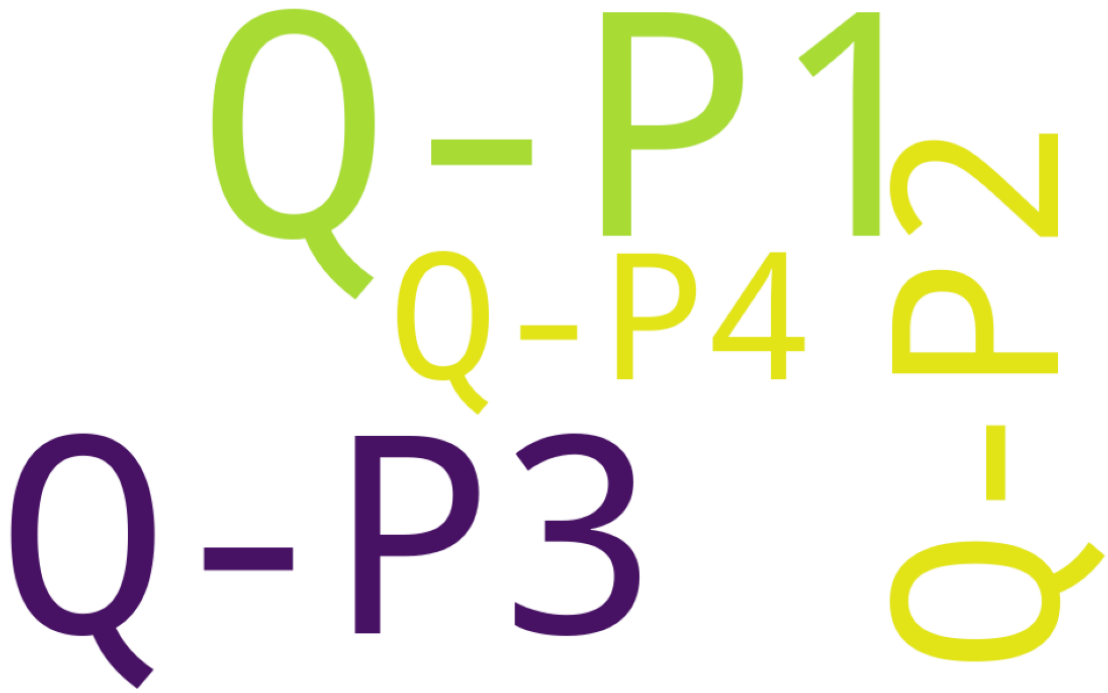
Out[27]:

	S-P1	S-P2	S-P3	S-P4
sum	6.010480e+07	6.212753e+07	7.842959e+07	3.684855e+07
max	2.535366e+04	2.534732e+04	3.252000e+04	1.426000e+04
min	8.051800e+02	1.591340e+03	1.355000e+03	1.782500e+03
mean	1.306626e+04	1.350598e+04	1.704991e+04	8.010555e+03

In [29]:
```
from wordcloud import WordCloud as word
d=data[["S-P1","S-P2","S-P3","S-P4"]].sum()
wc = word(background_color='white', width=1000, height=600)
wc.generate_from_frequencies(d)
plt.figure(figsize=(15,15),dpi=100)
plt.imshow(wc)
plt.axis('off')
plt.show()
```



In [30]:
```
q=data[["Q-P1","Q-P2","Q-P3","Q-P4"]].sum()
wc = word(background_color='white', width=1000, height=600)
wc.generate_from_frequencies(q)
plt.figure(figsize=(15,15),dpi=100)
plt.imshow(wc)
plt.axis('off')
plt.show()
```

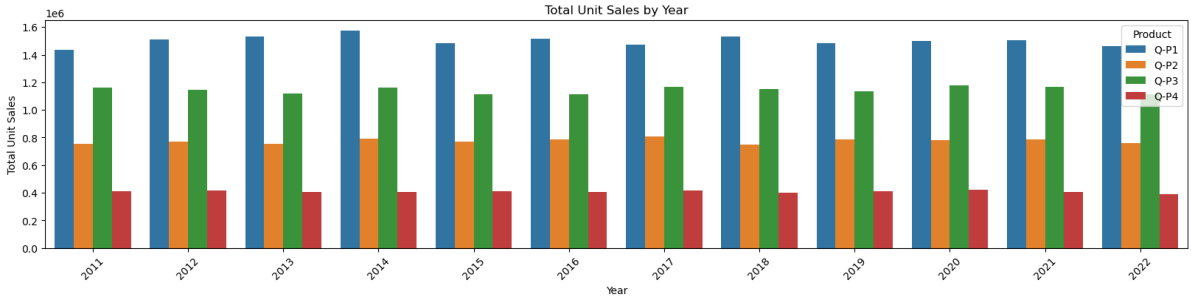


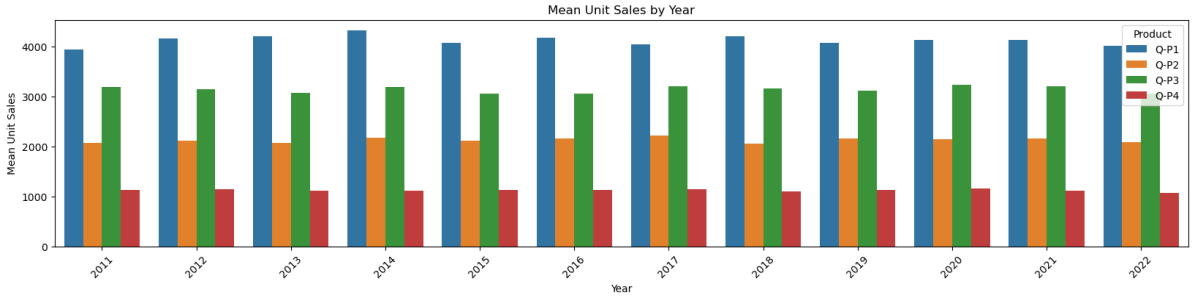
In [31]:
```
def plot_bar_chart(df, columns, stri, str1, val):
    if val == 'sum':
        sales_by_year = df.groupby('Year')[columns].sum().reset_index()
    elif val == 'mean':
        sales_by_year = df.groupby('Year')[columns].mean().reset_index()
    sales_by_year_melted = pd.melt(sales_by_year, id_vars='Year', value_vars=columr
    plt.figure(figsize=(20,4))
    sns.barplot(data=sales_by_year_melted, x='Year', y='Sales', hue='Product') #,pa
    plt.xlabel('Year')
```

```
    plt.ylabel(stri)
    plt.title(f'{stri} by {str1}')
    plt.xticks(rotation=45)
    plt.show()
```

In [32]:
```
plot_bar_chart(data_reduced, ['Q-P1', 'Q-P2', 'Q-P3', 'Q-P4'],'Total Unit Sales', '

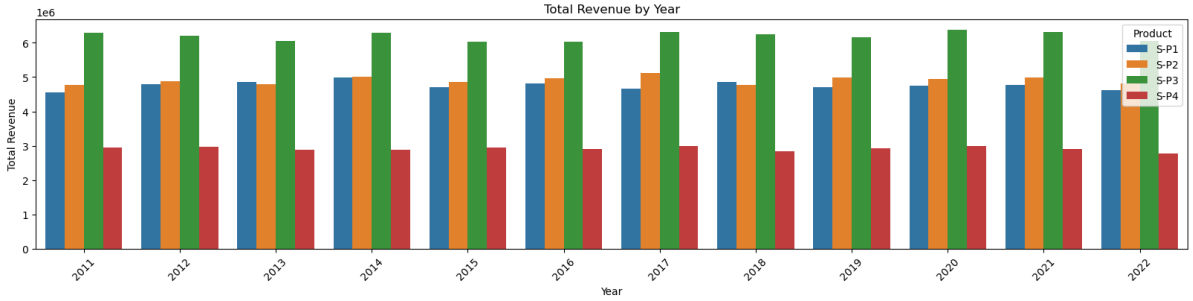
plot_bar_chart(data_reduced, ['Q-P1', 'Q-P2', 'Q-P3', 'Q-P4'],'Mean Unit Sales', 'Y
```

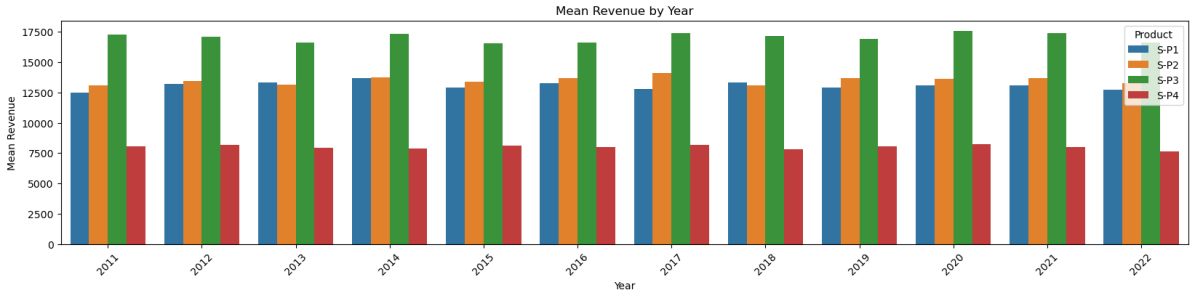




In [33]:
```
plot_bar_chart(data_reduced, ['S-P1', 'S-P2', 'S-P3', 'S-P4'], 'Total Revenue', 'Ye

plot_bar_chart(data_reduced, ['S-P1', 'S-P2', 'S-P3', 'S-P4'], 'Mean Revenue', 'Yea
```





In [34]:
```
data
```

Out[34]:

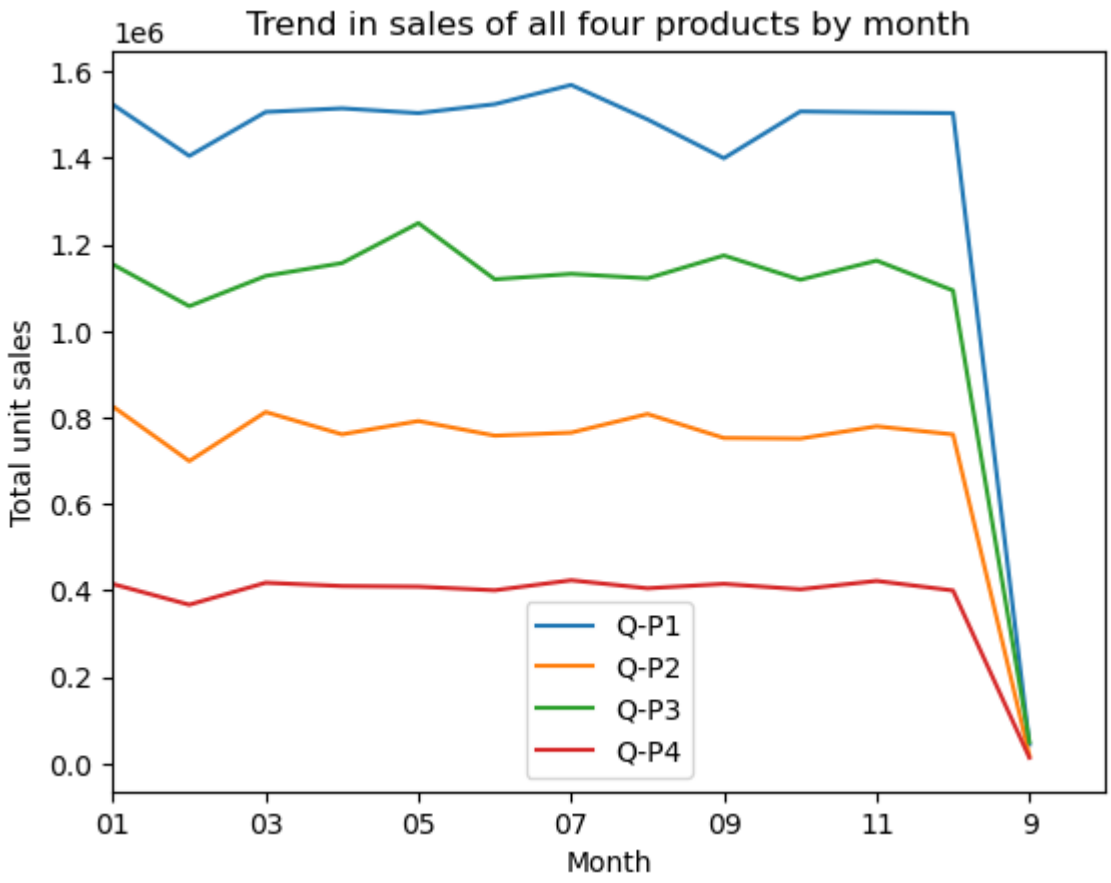
	Date	Q-P1	Q-P2	Q-P3	Q-P4	S-P1	S-P2	S-P3	S-P4	Day	Month	Year
0	2010-06-13	5422	3725	576	907	17187.74	23616.50	3121.92	6466.91	13	06	2010
1	2010-06-14	7047	779	3578	1574	22338.99	4938.86	19392.76	11222.62	14	06	2010
2	2010-06-15	1572	2082	595	1145	4983.24	13199.88	3224.90	8163.85	15	06	2010
3	2010-06-16	5657	2399	3140	1672	17932.69	15209.66	17018.80	11921.36	16	06	2010
4	2010-06-17	3668	3207	2184	708	11627.56	20332.38	11837.28	5048.04	17	06	2010
...	...	...	...	...	...	...	...	...	...	...	...	...
4595	2023-01-30	2476	3419	525	1359	7848.92	21676.46	2845.50	9689.67	30	01	2023
4596	2023-01-31	7446	841	4825	1311	23603.82	5331.94	26151.50	9347.43	31	01	2023
4597	2023-01-02	6289	3143	3588	474	19936.13	19926.62	19446.96	3379.62	01	02	2023
4598	2023-02-02	3122	1188	5899	517	9896.74	7531.92	31972.58	3686.21	02	02	2023
4599	2023-03-02	1234	3854	2321	406	3911.78	24434.36	12579.82	2894.78	03	02	2023

4600 rows × 12 columns

In [35]:

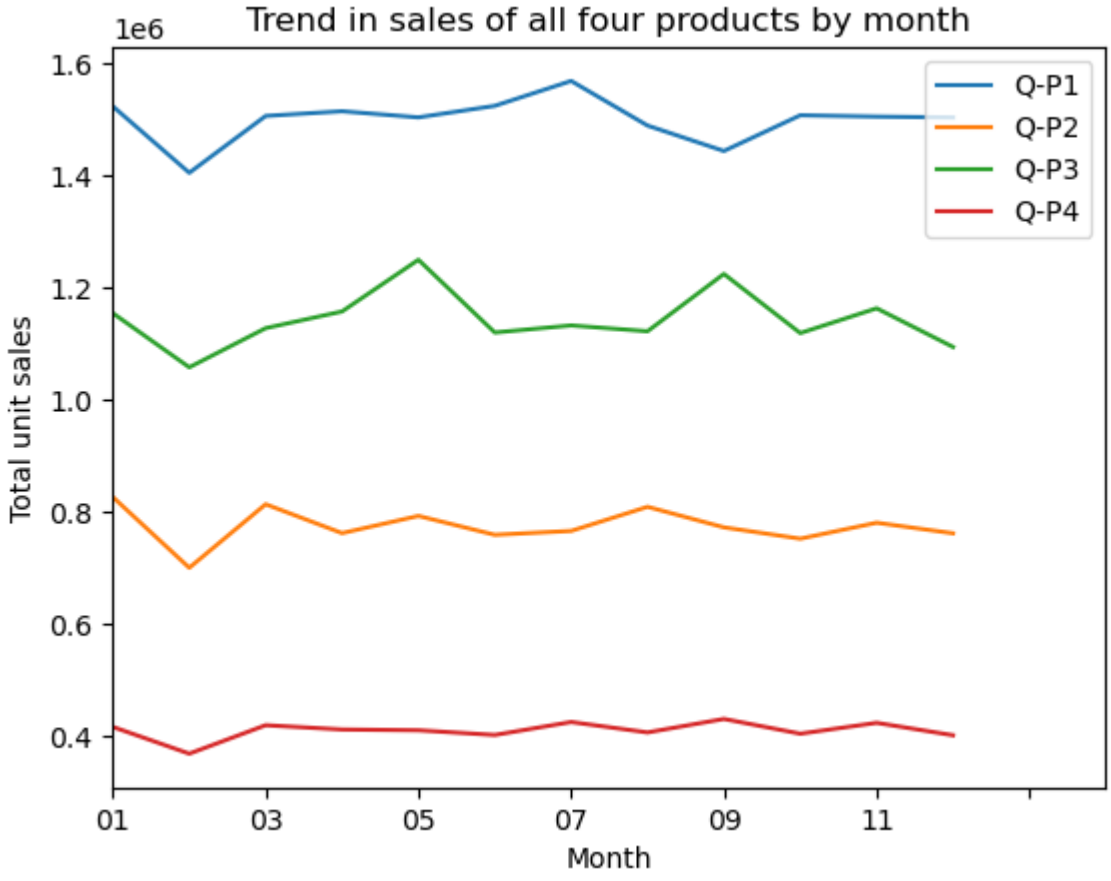
```
def month_plot():
    fig, ax = plt.subplots()
    data_reduced.groupby('Month')[['Q-P1', 'Q-P2', 'Q-P3', 'Q-P4']].sum().plot(ax=a
    ax.set_xlim(left=0, right=13)
    ax.set_xlabel('Month')
    ax.set_ylabel('Total unit sales')
    ax.set_title('Trend in sales of all four products by month')
    plt.show()

month_plot()
```



In [36]:
```
data_reduced['Month'] = data['Month'].replace('9', '09')
```

In [37]:
```
month_plot()
```



In [38]:
```
def month_31_data(df, months):
    m31_data = df[df['Month'].isin(months) & (df['Day'] == '31')]
```

```
    return m31_data

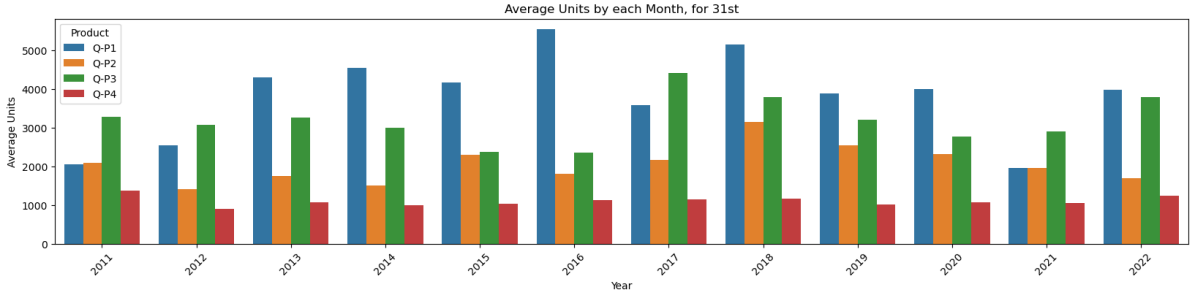
_31_months = month_31_data(data_reduced, ['01', '02', '03', '04', '05', '06', '07',
_31_months
```

Out[38]:

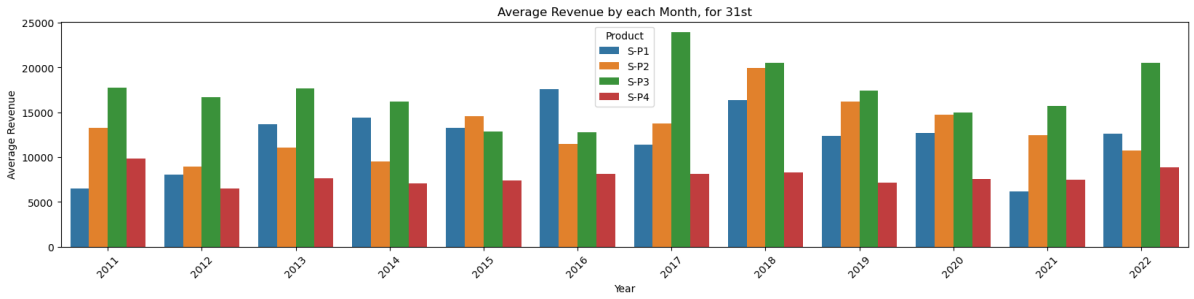
	Date	Q-P1	Q-P2	Q-P3	Q-P4	S-P1	S-P2	S-P3	S-P4	Day	Month	Year
231	31-01-2011	939	3325	1863	1612	2976.63	21080.50	10097.46	11493.56	31	01	2011
290	31-03-2011	464	2220	421	1663	1470.88	14074.80	2281.82	11857.19	31	03	2011
351	31-05-2011	1507	2980	3816	1202	4777.19	18893.20	20682.72	8570.26	31	05	2011
412	31-07-2011	4336	744	4717	667	13745.12	4716.96	25566.14	4755.71	31	07	2011
442	31-08-2011	4548	1484	1596	1974	14417.16	9408.56	8650.32	14074.62	31	08	2011
...	...	...	...	...	...	...	...	...	...	...	...	...
4352	31-05-2022	3669	2710	3067	1593	11630.73	17181.40	16623.14	11358.09	31	05	2022
4413	31-07-2022	1437	833	1867	1270	4555.29	5281.22	10119.14	9055.10	31	07	2022
4443	31-08-2022	1035	1639	3658	841	3280.95	10391.26	19826.36	5996.33	31	08	2022
4474	31-9-2022	6964	1873	5481	1336	22075.88	11874.82	29707.02	9525.68	31	09	2022
4535	31-11-2022	4600	2006	3796	1426	14582.00	12718.04	20574.32	10167.38	31	11	2022

84 rows × 12 columns

In [39]:
```
plot_bar_chart(_31_months, ['Q-P1', 'Q-P2', 'Q-P3', 'Q-P4'], 'Average Units', 'each
```



In [40]:
```
plot_bar_chart(_31_months, ['S-P1', 'S-P2', 'S-P3', 'S-P4'], 'Average Revenue', 'ea
```



In [41]:
```
def avg_on_31st(df, product):
    df_31 = df[df['Day'] == '31']
    avg_sales = df_31[product].mean()
    return avg_sales
```

In [42]:
```
avg_on_31st(data_reduced, ['Q-P1', 'Q-P2', 'Q-P3', 'Q-P4']).round(2)
```

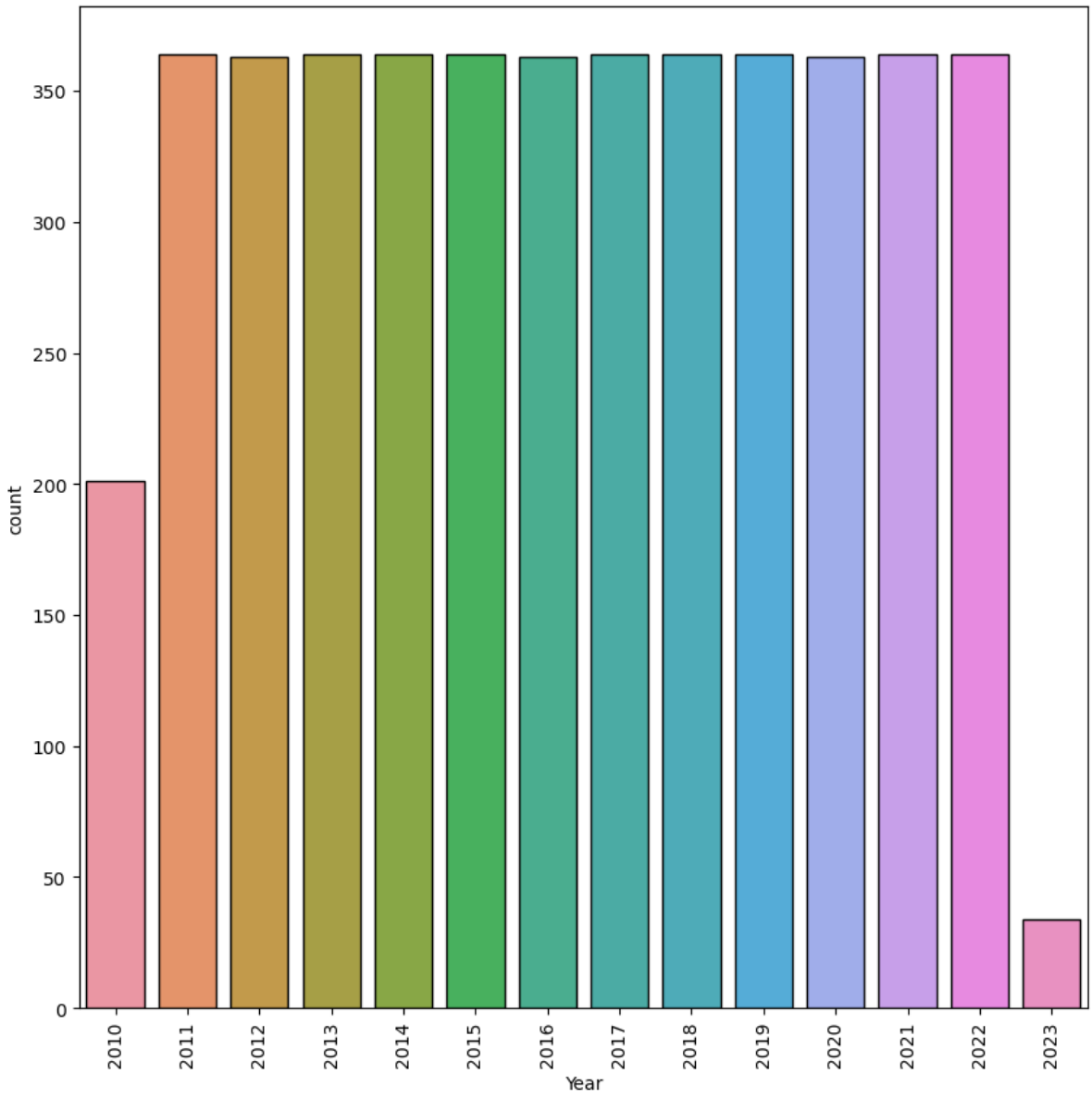
Out[42]:
```
Q-P1    3813.74
Q-P2    2058.80
Q-P3    3183.88
Q-P4    1098.61
dtype: float64
```

In [43]:
```
avg_on_31st(data_reduced, ['S-P1', 'S-P2', 'S-P3', 'S-P4']).round(2)
```

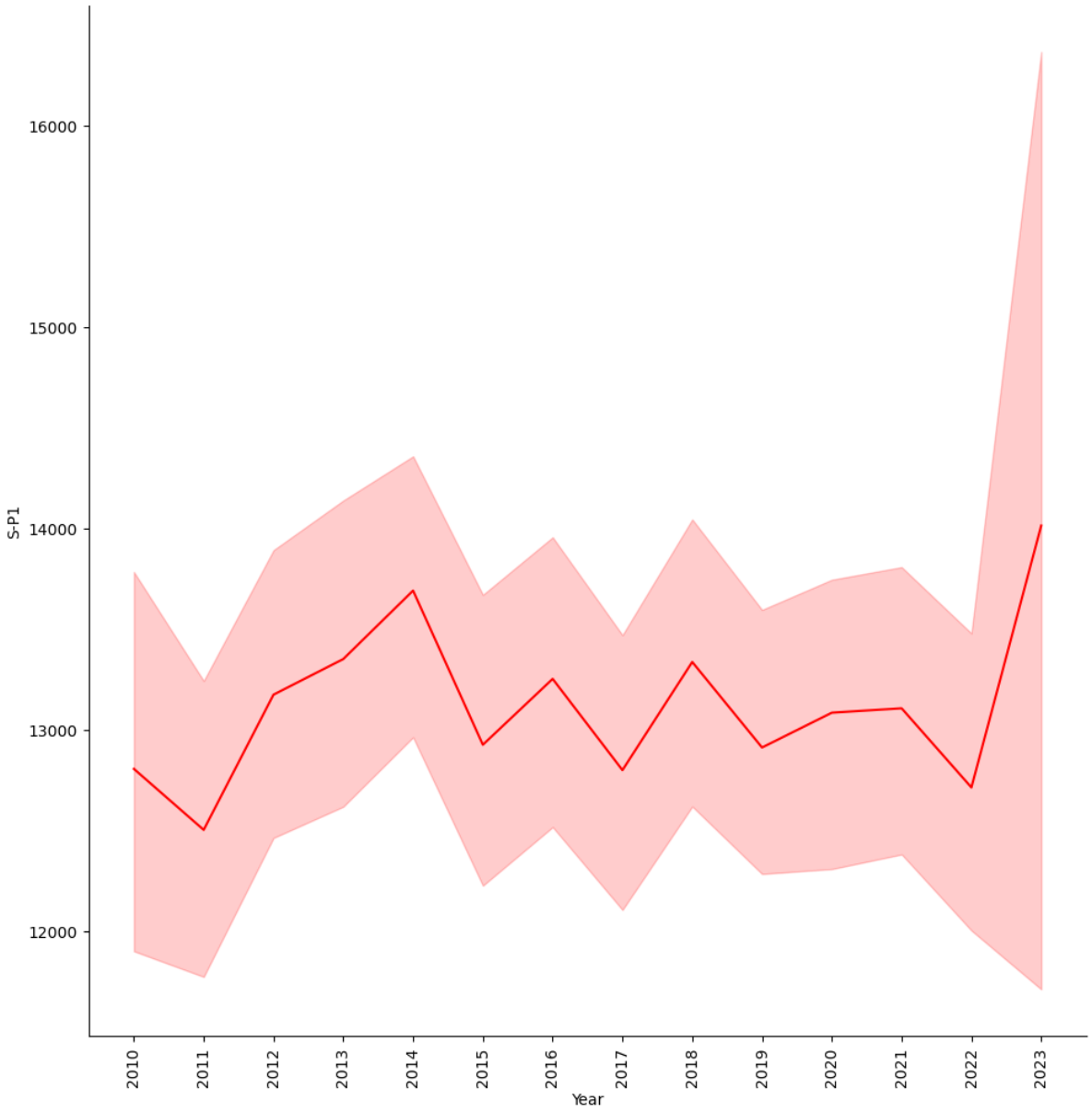
Out[43]:
```
S-P1    12089.55
S-P2    13052.78
S-P3    17256.63
S-P4     7833.07
dtype: float64
```

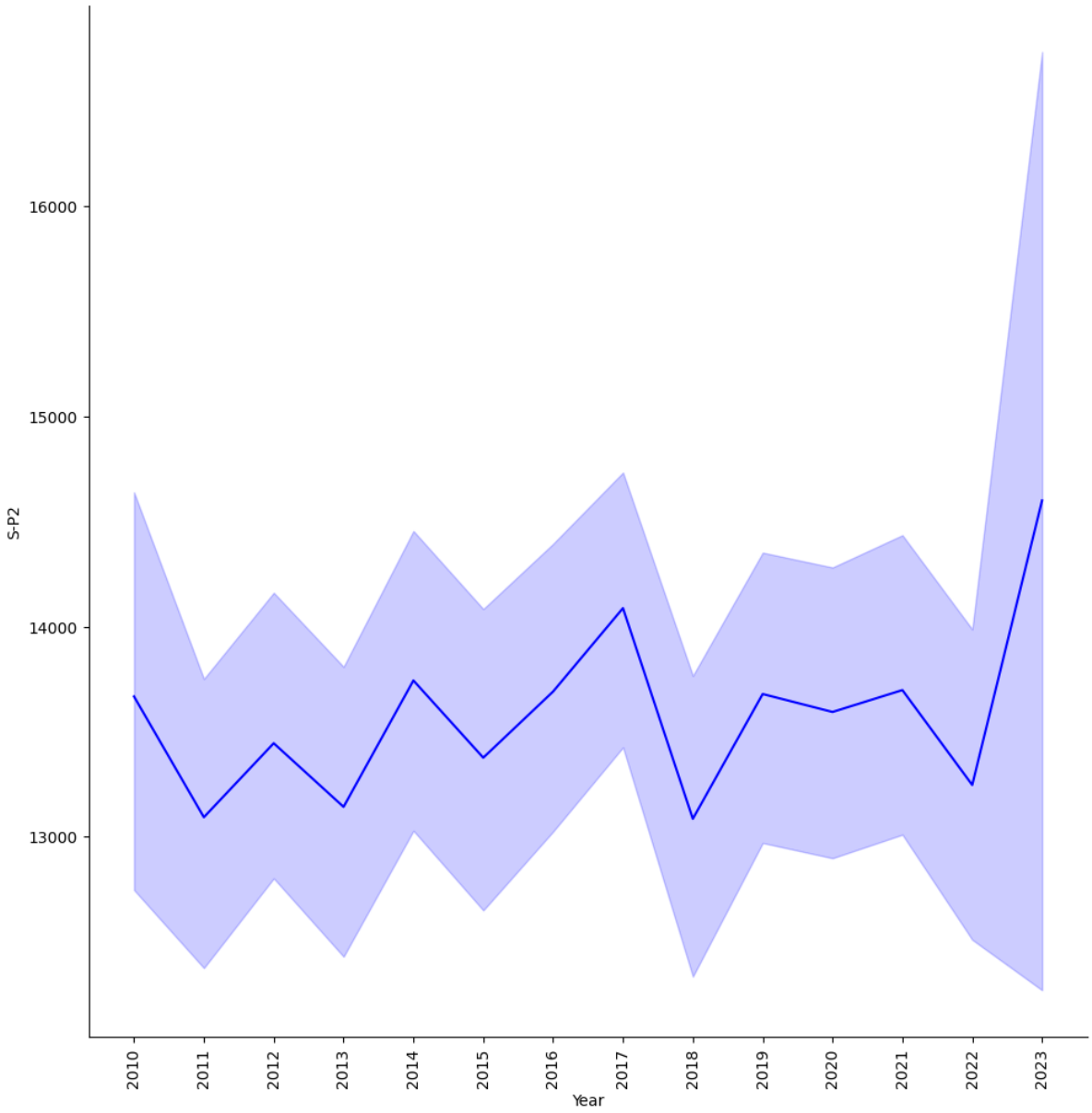
In [46]:
```
print(data["Year"].value_counts())
plt.figure(figsize=(10,10))
sns.countplot(x="Year",data=data,edgecolor="black")
plt.xticks(rotation=90);
```

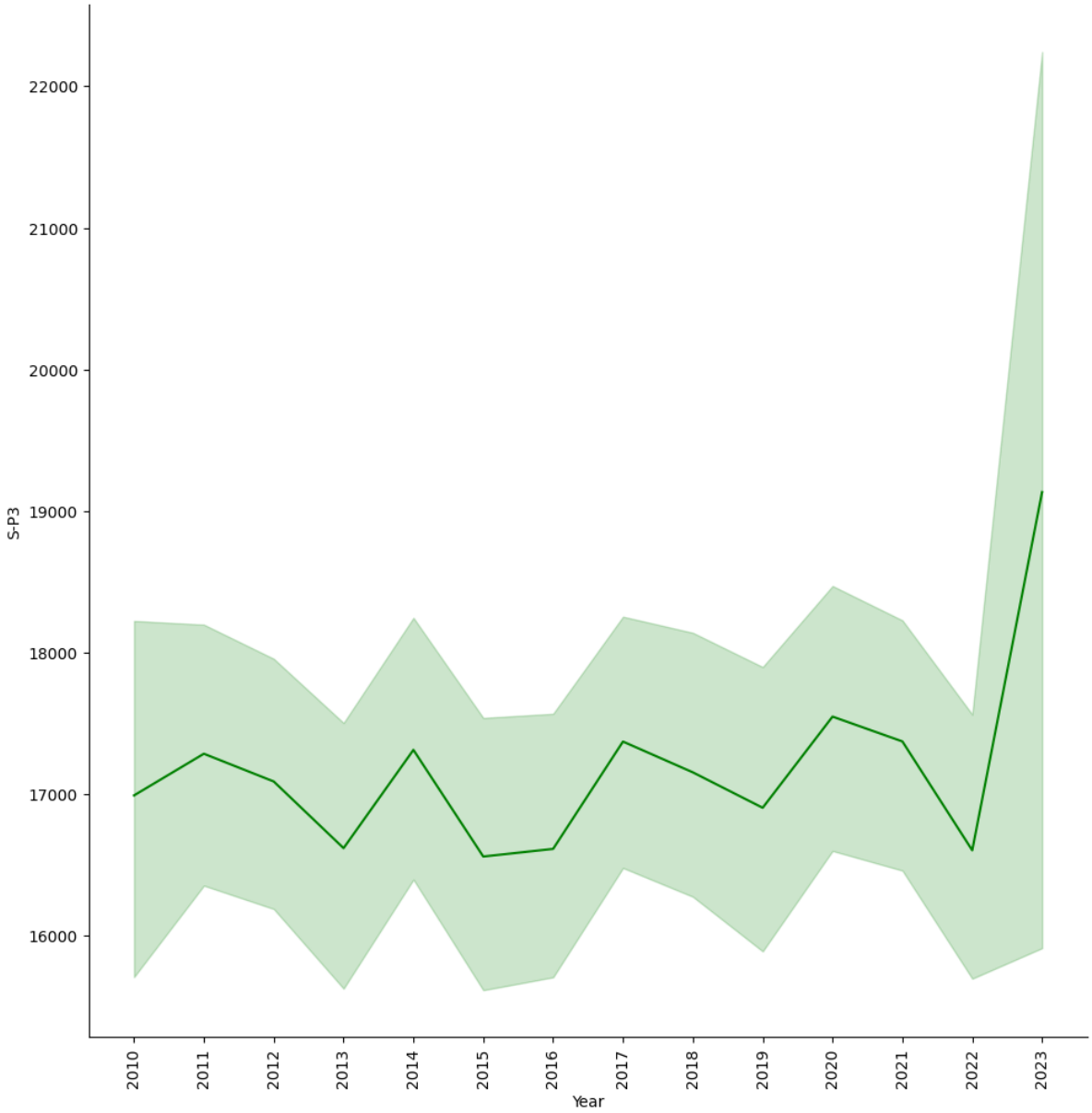
```
2011    364
2013    364
2014    364
2015    364
2017    364
2018    364
2019    364
2021    364
2022    364
2012    363
2016    363
2020    363
2010    201
2023     34
Name: Year, dtype: int64
```

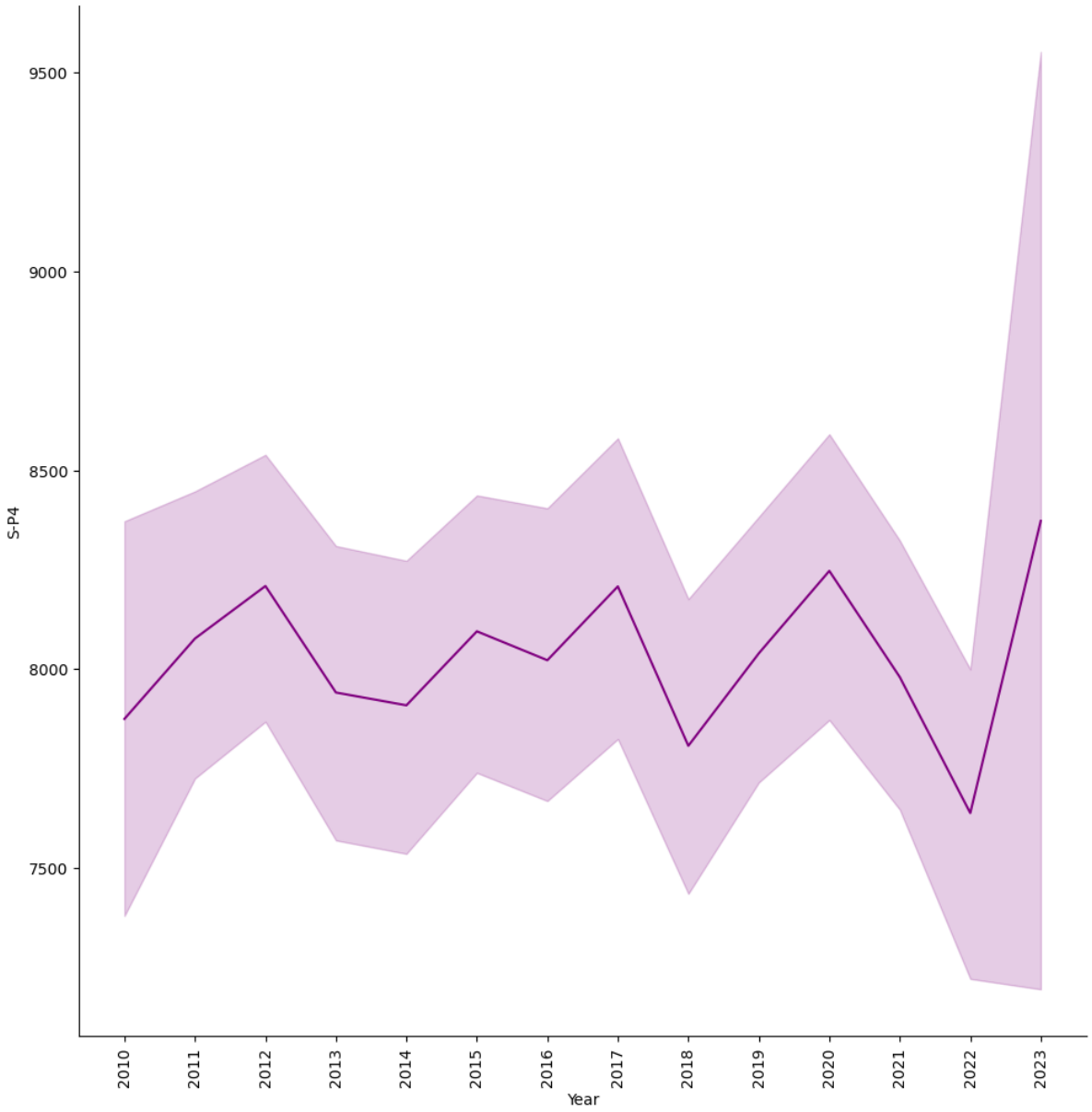


In [47]:
```
sns.relplot(x="Year",y="S-P1",data=data,kind="line",height=10,color="red")
plt.xticks(rotation=90);
sns.relplot(x="Year",y="S-P2",data=data,kind="line",height=10,color="blue")
plt.xticks(rotation=90);
sns.relplot(x="Year",y="S-P3",data=data,kind="line",height=10,color="green")
plt.xticks(rotation=90);
sns.relplot(x="Year",y="S-P4",data=data,kind="line",height=10,color="purple")
plt.xticks(rotation=90);
```

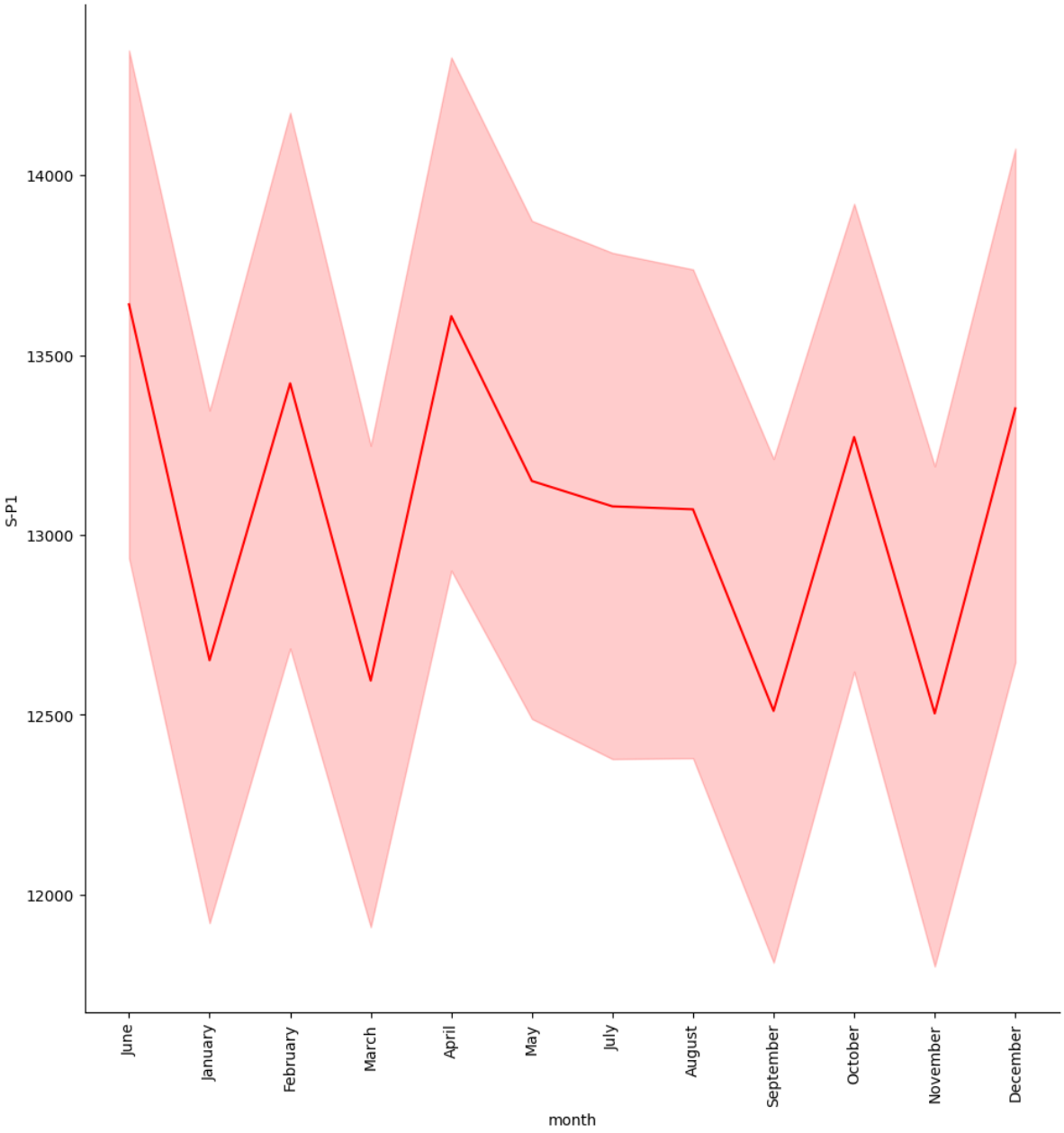

S-P1
16000
15000
14000
13000
12000
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year

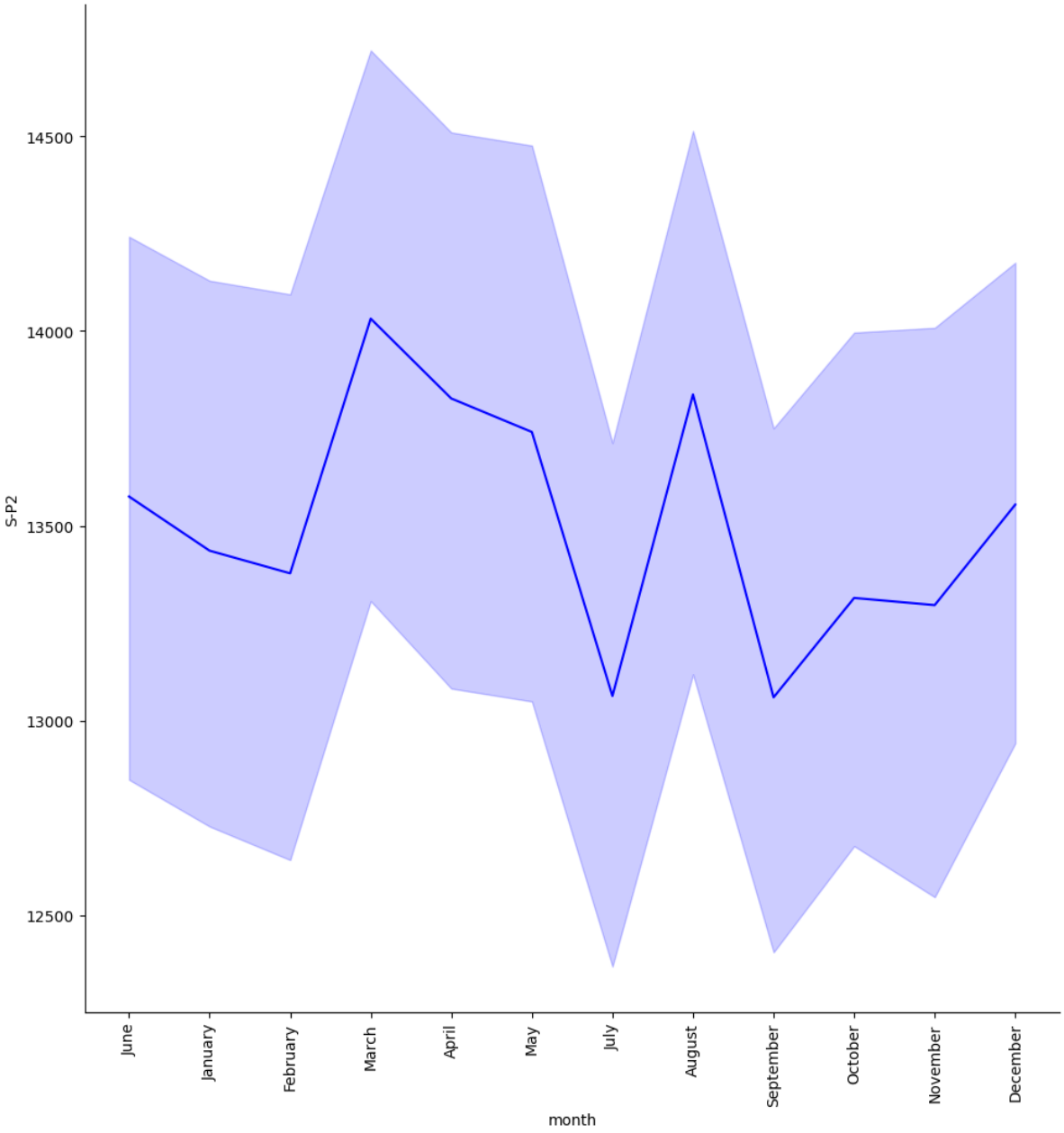

16000
15000
14000
13000
S-P2
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year

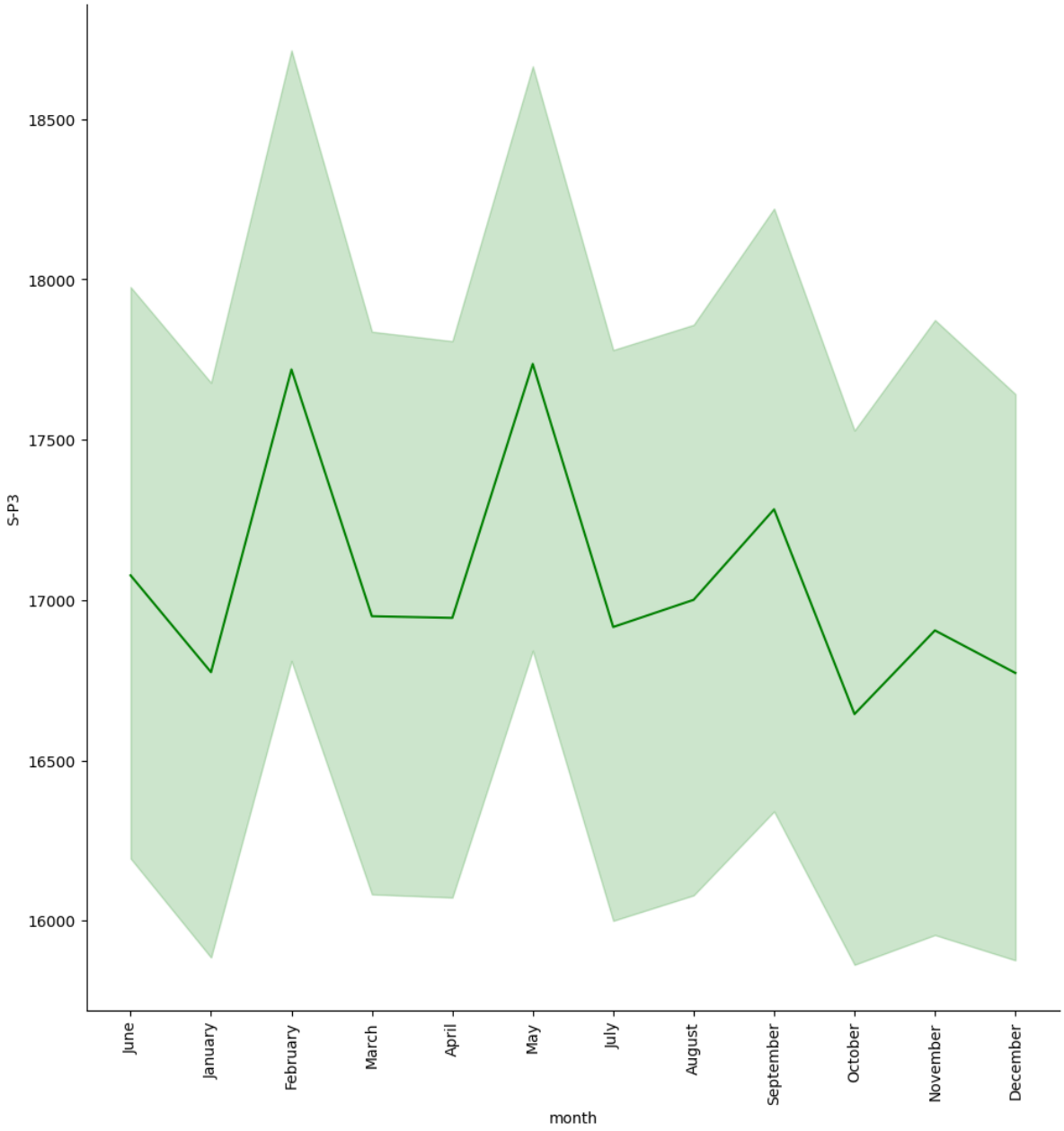

S-P3
22000
21000
20000
19000
18000
17000
16000
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year

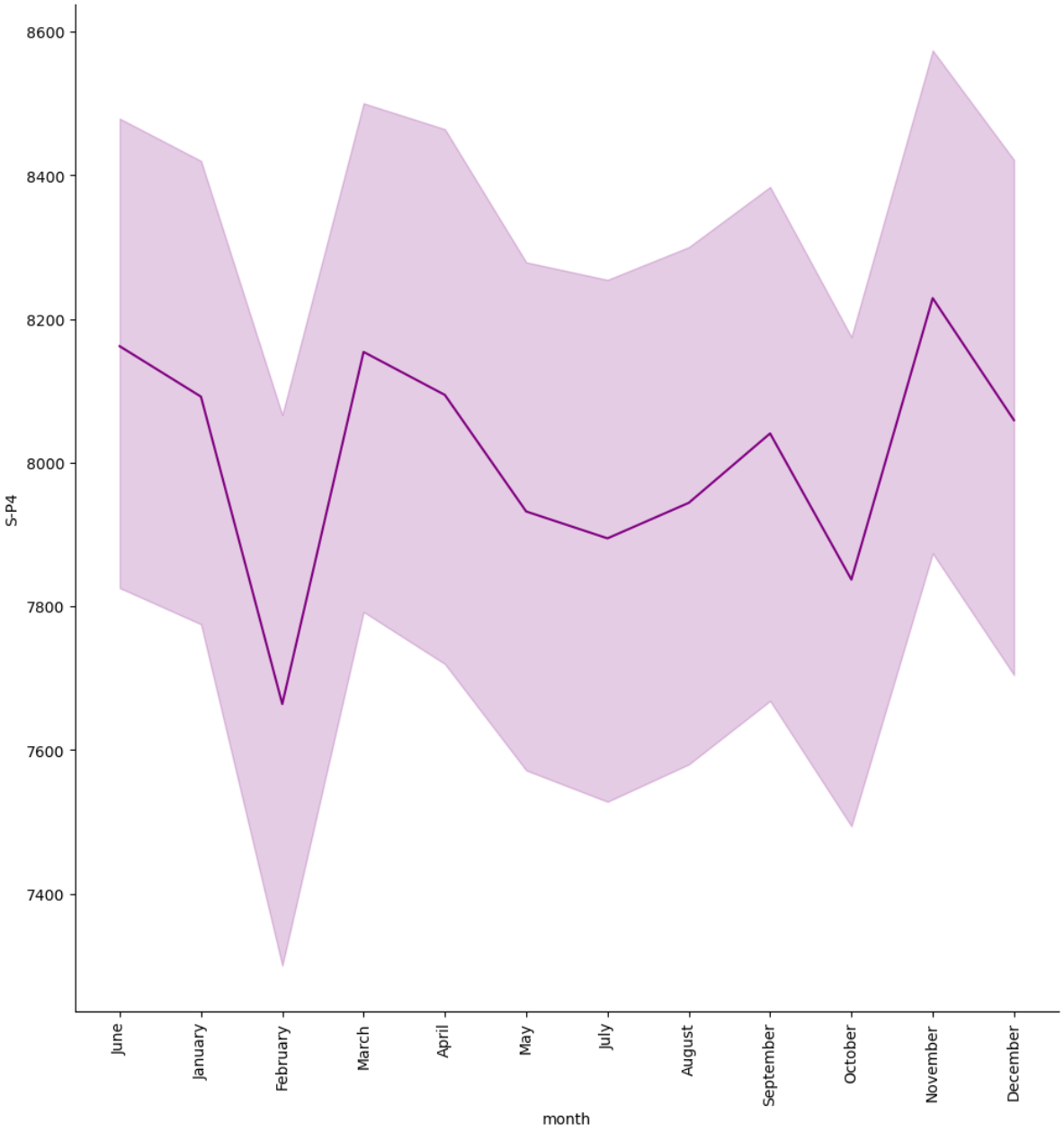


In [64]:
```
# Monthly distrubution of revenue
sns.relplot(x="month",y="S-P1",data=data,kind="line",height=10,color="red")
plt.xticks(rotation=90);
sns.relplot(x="month",y="S-P2",data=data,kind="line",height=10,color="blue")
plt.xticks(rotation=90);
sns.relplot(x="month",y="S-P3",data=data,kind="line",height=10,color="green")
plt.xticks(rotation=90);
sns.relplot(x="month",y="S-P4",data=data,kind="line",height=10,color="purple")
plt.xticks(rotation=90);
```


14000
13500
13000
12500
12000
S-P1
June
January
February
March
April
May
July
August
September
October
November
December
month


14500
14000
13500
13000
12500
S-P2
June
January
February
March
April
May
July
August
September
October
November
December
month


18500
18000
17500
17000
16500
16000
S-P3
June
January
February
March
April
May
July
August
September
October
November
December
month



In [65]:
```
data.groupby("month")[["S-P1","S-P2","S-P3","S-P4"]].sum()
```

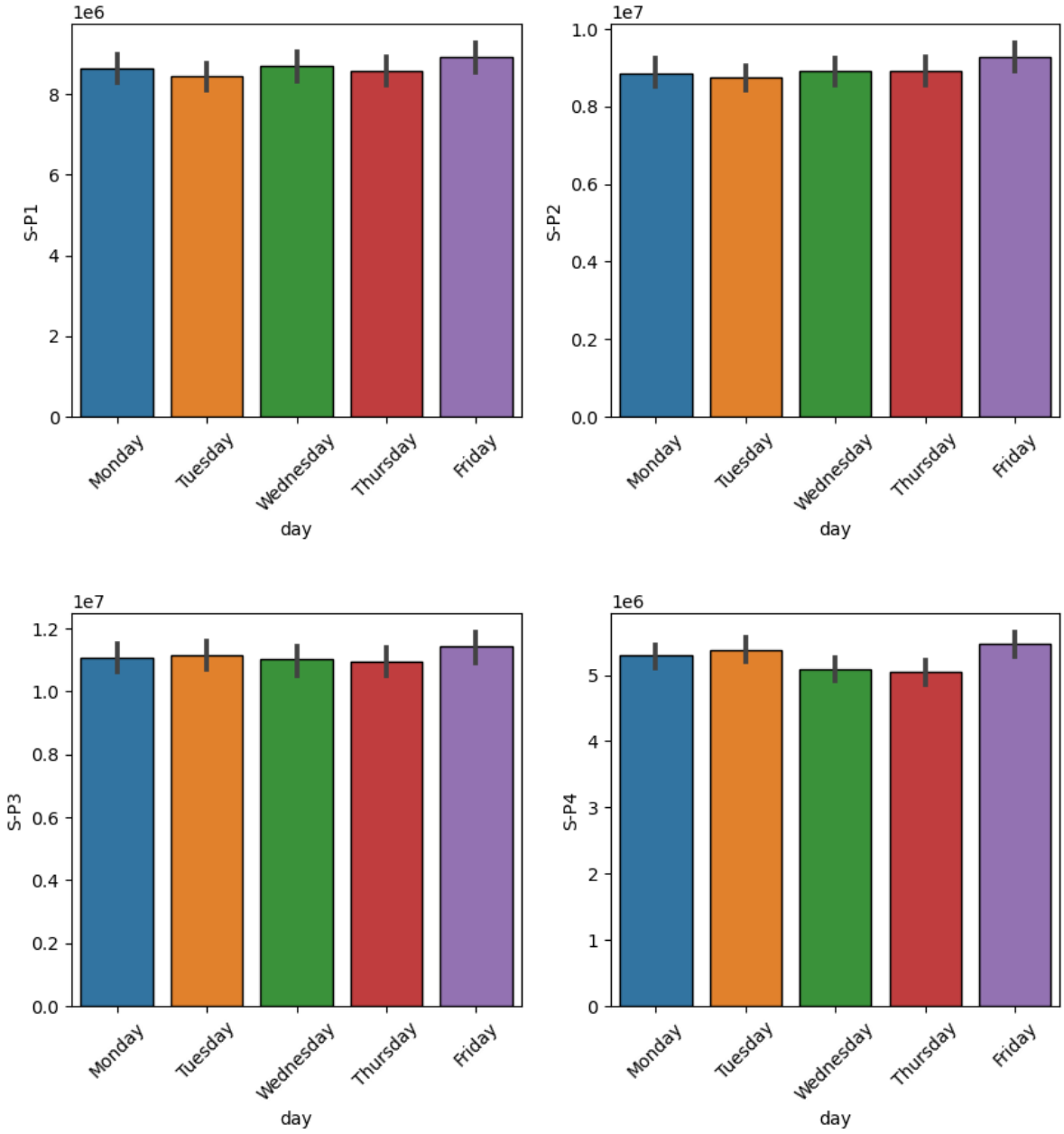
Out[65]:

month	S-P1	S-P2	S-P3	S-P4
April	4994236.73	5074402.86	6218523.18	2970628.94
August	5032438.40	5327280.10	6545224.52	3058499.06
December	5140424.45	5218441.32	6457398.84	3102797.75
February	4576731.88	4561845.56	6042134.70	2613444.46
January	5048012.61	5360970.86	6693223.04	3228692.16
July	5205647.20	5199104.32	6732490.94	3142091.18
June	5251837.27	5226404.36	6574600.92	3142454.81
March	4786119.89	5332035.10	6440791.96	3098619.57
May	4983870.83	5207752.08	6722008.66	3006278.94
November	4813933.47	5119068.16	6508476.92	3168215.50
October	5454847.24	5472326.62	6840809.64	3221134.36
September	4816704.05	5027898.96	6653906.36	3095696.27

In [67]:
```
week_t=data[data["dayoftheweek"]<5]
weekend_t=data[data["dayoftheweek"]>=5]
print(week_t.groupby("day")[["S-P1","S-P2","S-P3","S-P4"]].sum())
```

```
                S-P1        S-P2         S-P3        S-P4
day
Friday     8913637.41  9267831.02  11428877.58  5463169.99
Monday     8636791.80  8864347.08  11064892.06  5292577.61
Thursday   8577981.96  8909481.54  10951554.44  5043013.35
Tuesday    8433525.06  8738326.90  11156338.30  5384854.07
Wednesday  8693537.97  8908067.72  11017830.20  5086827.20
```

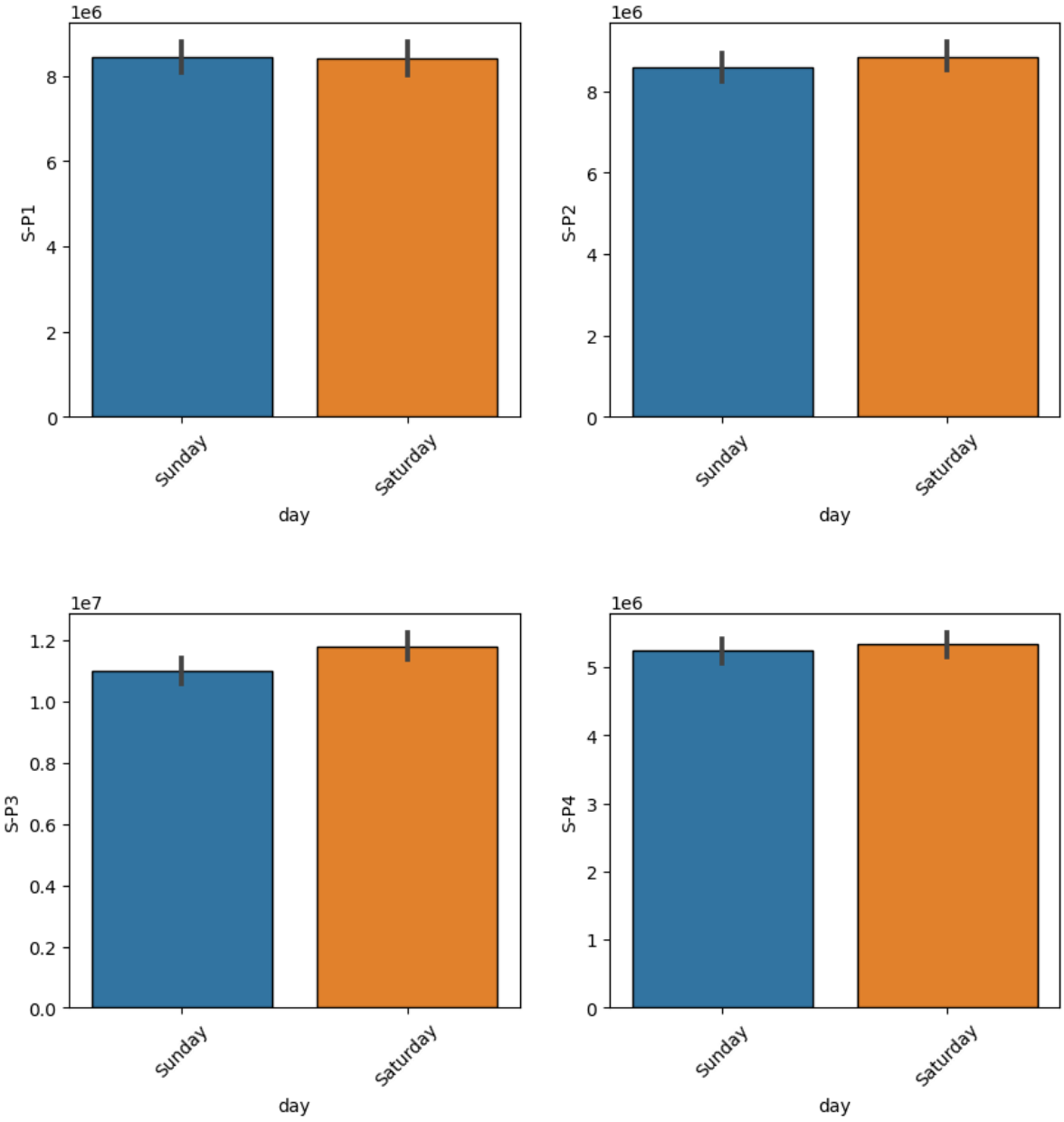
In [68]:
```
plt.figure(figsize=(10,10),dpi=100)
plt.subplot(2,2,1)
sns.barplot(x="day",y="S-P1",data=week_t,edgecolor="black",estimator=sum)
plt.xticks(rotation=45);
plt.subplot(2,2,2)
sns.barplot(x="day",y="S-P2",data=week_t,edgecolor="black",estimator=sum)
plt.xticks(rotation=45);
plt.subplot(2,2,3)
sns.barplot(x="day",y="S-P3",data=week_t,edgecolor="black",estimator=sum)
plt.xticks(rotation=45);
plt.subplot(2,2,4)
sns.barplot(x="day",y="S-P4",data=week_t,edgecolor="black",estimator=sum)
plt.xticks(rotation=45)
plt.subplots_adjust(hspace=0.5);
```



In [69]:
```
print(weekend_t.groupby("day")[["S-P1","S-P2","S-P3","S-P4"]].sum())
```

```
                S-P1        S-P2         S-P3        S-P4
day
Saturday  8409578.88  8853201.36  11796375.26  5339977.85
Sunday    8439750.94  8586274.68  11013721.84  5238132.93
```

In [70]:
```
plt.figure(figsize=(10,10),dpi=100)
plt.subplot(2,2,1)
sns.barplot(x="day",y="S-P1",data=weekend_t,edgecolor="black",estimator=sum)
plt.xticks(rotation=45);
plt.subplot(2,2,2)
sns.barplot(x="day",y="S-P2",data=weekend_t,edgecolor="black",estimator=sum)
plt.xticks(rotation=45);
plt.subplot(2,2,3)
sns.barplot(x="day",y="S-P3",data=weekend_t,edgecolor="black",estimator=sum)
plt.xticks(rotation=45);
plt.subplot(2,2,4)
sns.barplot(x="day",y="S-P4",data=weekend_t,edgecolor="black",estimator=sum)
plt.xticks(rotation=45)
plt.subplots_adjust(hspace=0.5);
```

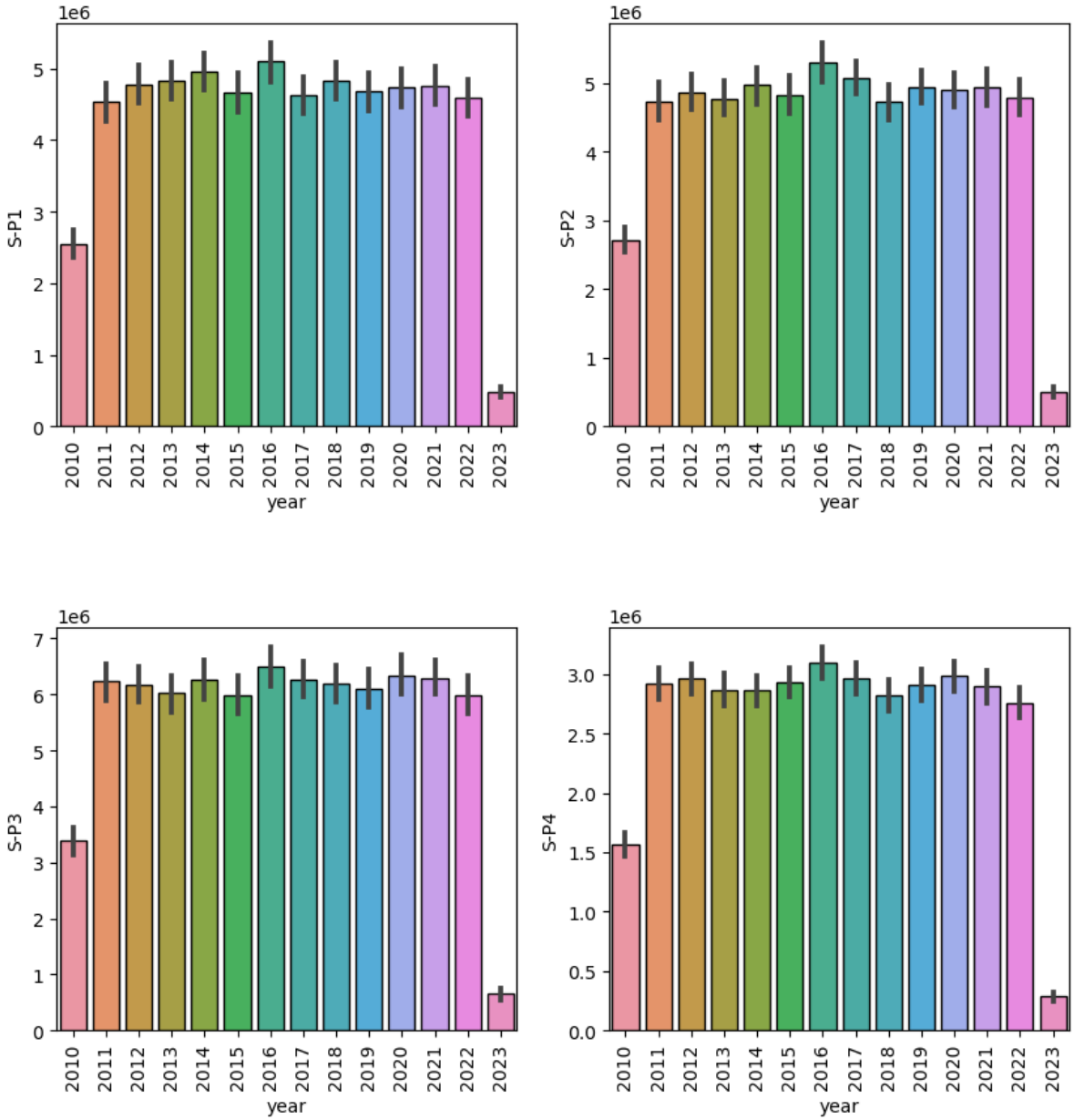


In [71]:
```
data.groupby("year")[["S-P1","S-P2","S-P3","S-P4"]].agg(["sum"])
```

Out[71]:

	S-P1	S-P2	S-P3	S-P4
	sum	sum	sum	sum
year				
2010	2543459.01	2720100.92	3385462.08	1567523.37
2011	4542819.22	4741147.10	6235075.86	2921603.06
2012	4771163.83	4861987.50	6173911.16	2965210.14
2013	4833682.57	4771369.88	6017809.74	2868491.69
2014	4954522.97	4979797.38	6265406.18	2865119.20
2015	4669720.66	4833806.20	5987988.90	2933224.96
2016	5096066.64	5313116.54	6507718.12	3096444.92
2017	4628545.53	5085909.96	6269568.74	2969944.46
2018	4825792.44	4727313.22	6198517.96	2824392.64
2019	4681354.56	4946303.16	6106237.04	2912519.44
2020	4732093.58	4904826.88	6343643.88	2984618.00
2021	4758100.26	4948382.68	6294208.06	2894394.98
2022	4591000.05	4797040.54	5993479.36	2760400.89
2023	476482.70	496428.34	650562.60	284665.25

In [73]:
```
plt.figure(figsize=(10,10),dpi=100)
plt.subplot(2,2,1)
sns.barplot(x="year",y="S-P1",data=data,edgecolor="black",estimator=sum)
plt.xticks(rotation=90);
plt.subplot(2,2,2)
sns.barplot(x="year",y="S-P2",data=data,edgecolor="black",estimator=sum)
plt.xticks(rotation=90);
plt.subplot(2,2,3)
sns.barplot(x="year",y="S-P3",data=data,edgecolor="black",estimator=sum)
plt.xticks(rotation=90);
plt.subplot(2,2,4)
sns.barplot(x="year",y="S-P4",data=data,edgecolor="black",estimator=sum)
plt.xticks(rotation=90)
plt.subplots_adjust(hspace=0.5);
```



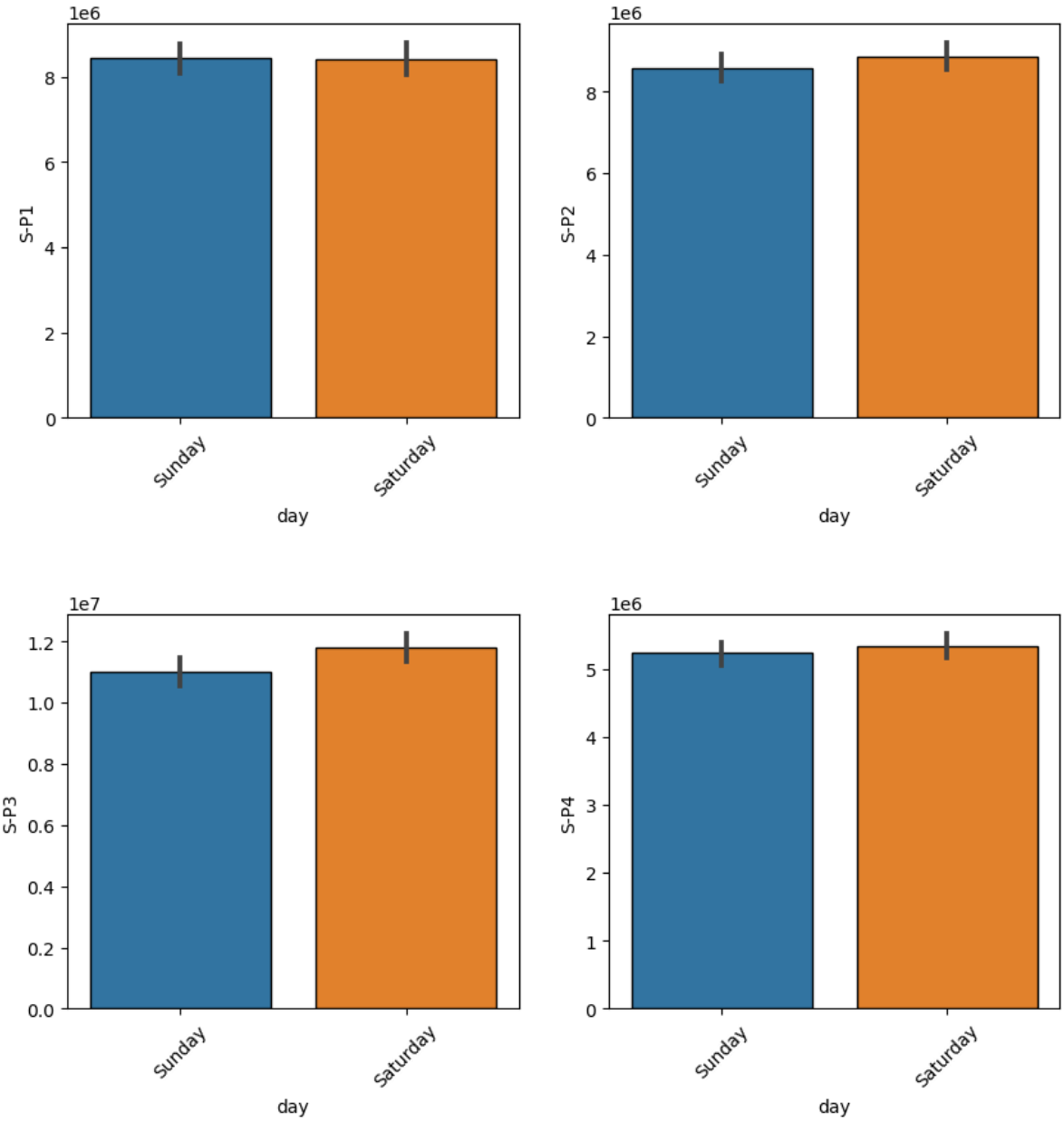
In [74]:
```
data[["S-P1","S-P2","S-P3","S-P4"]].agg(["sum","max","min","mean"])
```

Out[74]:

	S-P1	S-P2	S-P3	S-P4
sum	6.010480e+07	6.212753e+07	7.842959e+07	3.684855e+07
max	2.535366e+04	2.534732e+04	3.252000e+04	1.426000e+04
min	8.051800e+02	1.591340e+03	1.355000e+03	1.782500e+03
mean	1.306626e+04	1.350598e+04	1.704991e+04	8.010555e+03

In [75]:
```
plt.figure(figsize=(10,10),dpi=100)
plt.subplot(2,2,1)
sns.barplot(x="day",y="S-P1",data=weekend_t,edgecolor="black",estimator=sum)
plt.xticks(rotation=45);
plt.subplot(2,2,2)
sns.barplot(x="day",y="S-P2",data=weekend_t,edgecolor="black",estimator=sum)
plt.xticks(rotation=45);
plt.subplot(2,2,3)
sns.barplot(x="day",y="S-P3",data=weekend_t,edgecolor="black",estimator=sum)
plt.xticks(rotation=45);
plt.subplot(2,2,4)
sns.barplot(x="day",y="S-P4",data=weekend_t,edgecolor="black",estimator=sum)
```

```
plt.xticks(rotation=45)
plt.subplots_adjust(hspace=0.5);
```



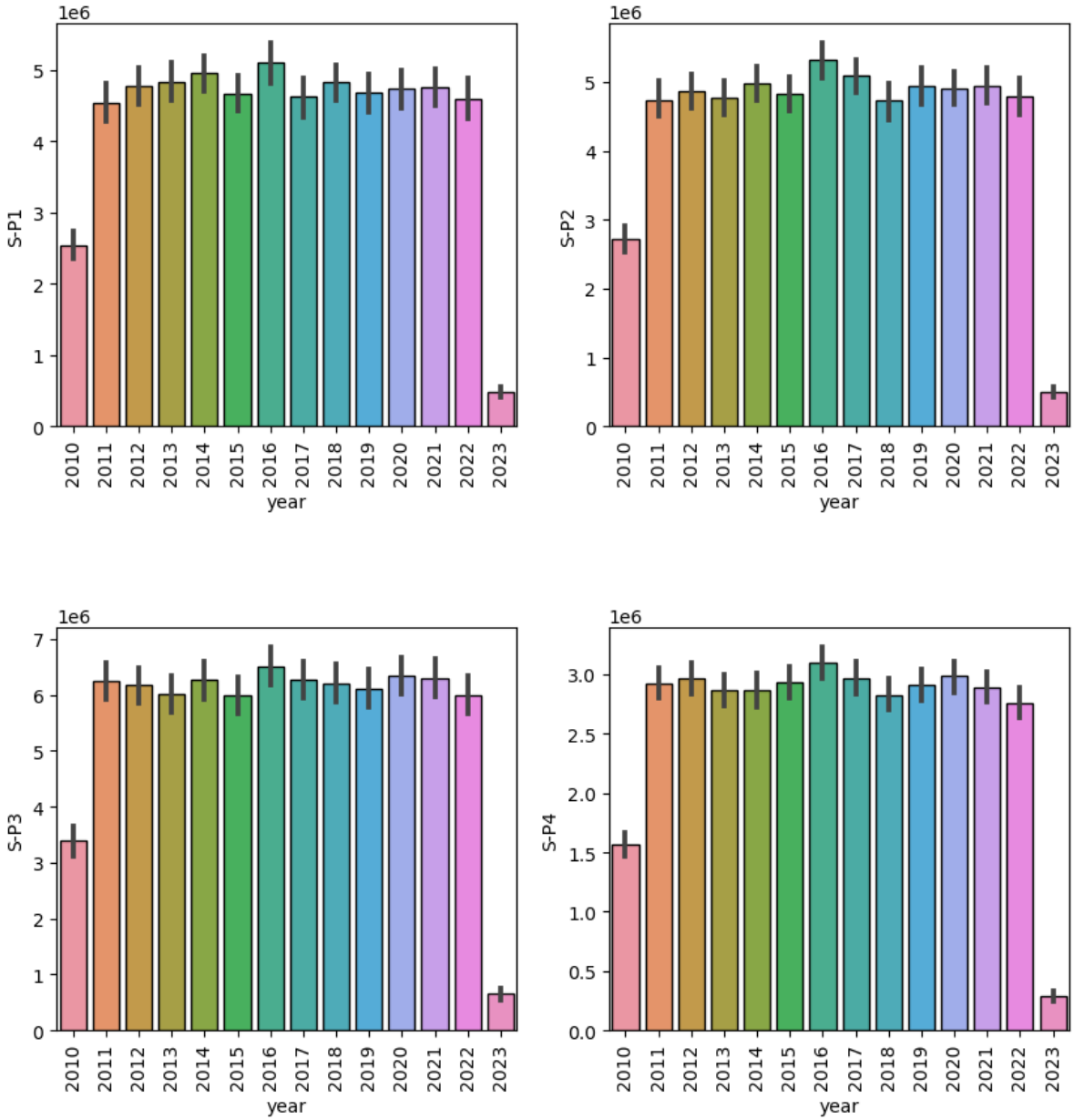
In [76]:
```
data.groupby("year")[["S-P1","S-P2","S-P3","S-P4"]].agg(["sum"])
```

Out[76]:

	S-P1	S-P2	S-P3	S-P4
	sum	sum	sum	sum
year				
2010	2543459.01	2720100.92	3385462.08	1567523.37
2011	4542819.22	4741147.10	6235075.86	2921603.06
2012	4771163.83	4861987.50	6173911.16	2965210.14
2013	4833682.57	4771369.88	6017809.74	2868491.69
2014	4954522.97	4979797.38	6265406.18	2865119.20
2015	4669720.66	4833806.20	5987988.90	2933224.96
2016	5096066.64	5313116.54	6507718.12	3096444.92
2017	4628545.53	5085909.96	6269568.74	2969944.46
2018	4825792.44	4727313.22	6198517.96	2824392.64
2019	4681354.56	4946303.16	6106237.04	2912519.44
2020	4732093.58	4904826.88	6343643.88	2984618.00
2021	4758100.26	4948382.68	6294208.06	2894394.98
2022	4591000.05	4797040.54	5993479.36	2760400.89
2023	476482.70	496428.34	650562.60	284665.25

In [78]:

```
plt.figure(figsize=(10,10),dpi=100)
plt.subplot(2,2,1)
sns.barplot(x="year",y="S-P1",data=data,edgecolor="black",estimator=sum)
plt.xticks(rotation=90);
plt.subplot(2,2,2)
sns.barplot(x="year",y="S-P2",data=data,edgecolor="black",estimator=sum)
plt.xticks(rotation=90);
plt.subplot(2,2,3)
sns.barplot(x="year",y="S-P3",data=data,edgecolor="black",estimator=sum)
plt.xticks(rotation=90);
plt.subplot(2,2,4)
sns.barplot(x="year",y="S-P4",data=data,edgecolor="black",estimator=sum)
plt.xticks(rotation=90)
plt.subplots_adjust(hspace=0.5);
```



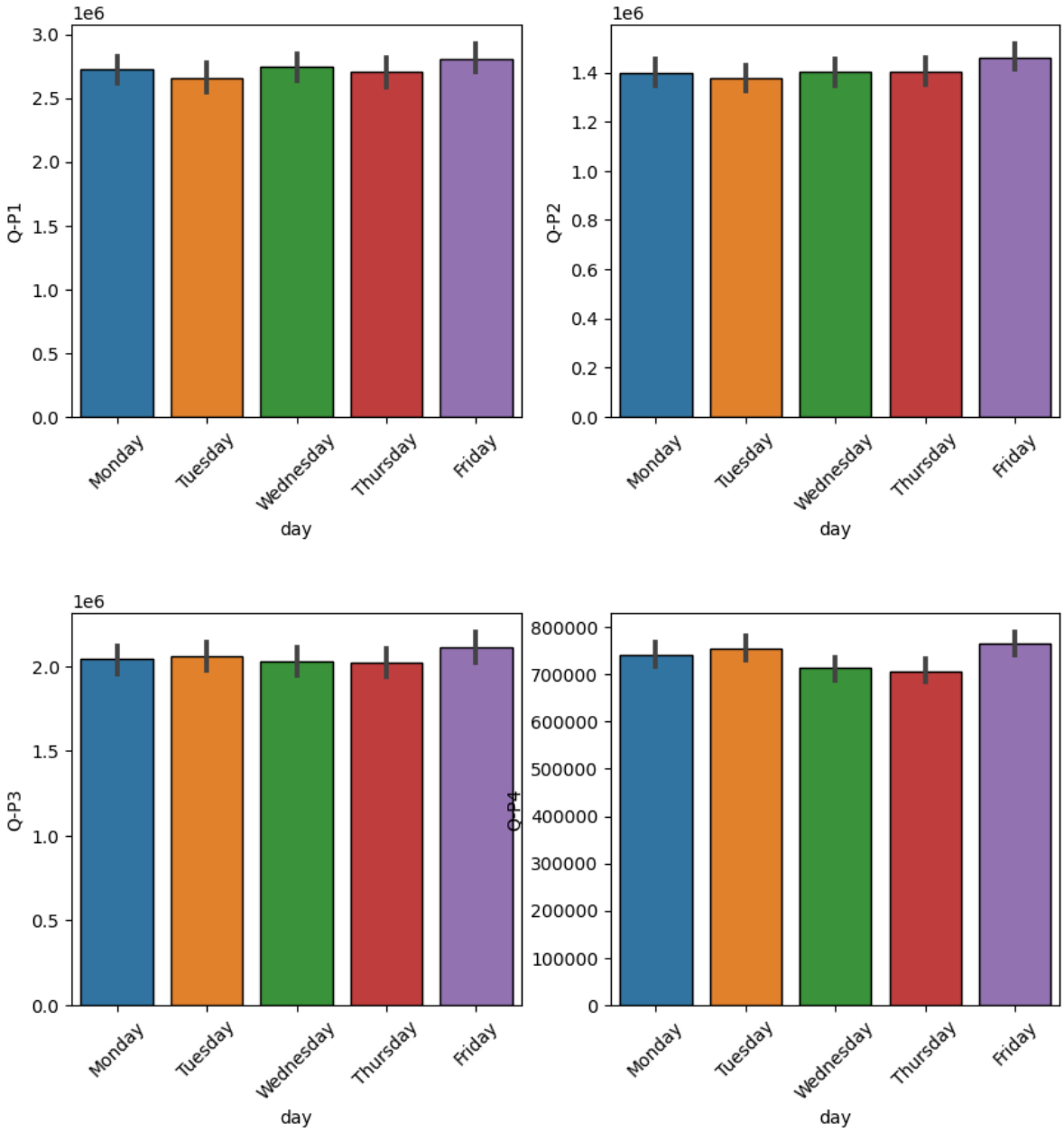
In [81]:
```
data[["S-P1","S-P2","S-P3","S-P4"]].agg(["sum","max","min","mean"])
```

Out[81]:

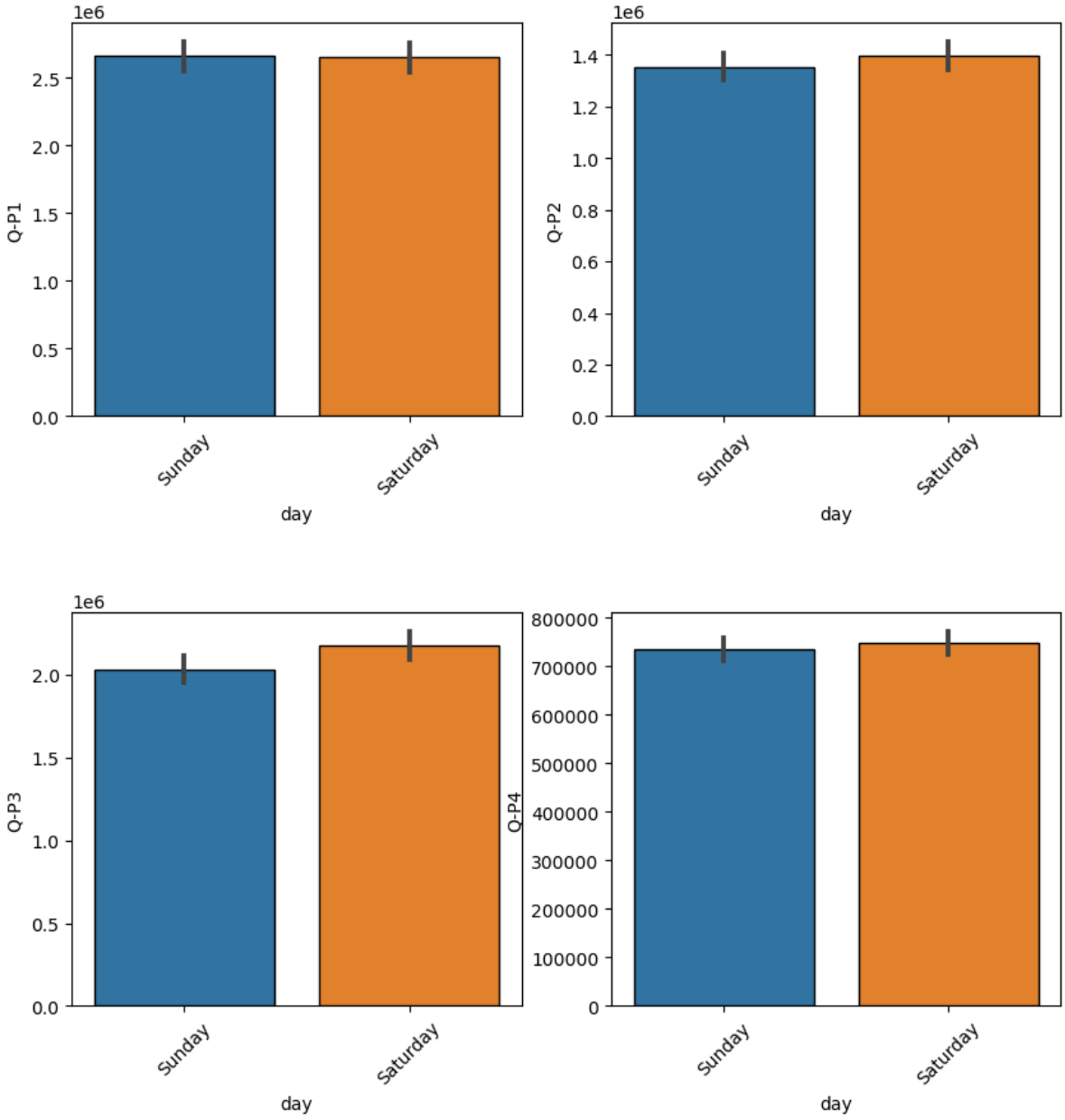
	S-P1	S-P2	S-P3	S-P4
sum	6.010480e+07	6.212753e+07	7.842959e+07	3.684855e+07
max	2.535366e+04	2.534732e+04	3.252000e+04	1.426000e+04
min	8.051800e+02	1.591340e+03	1.355000e+03	1.782500e+03
mean	1.306626e+04	1.350598e+04	1.704991e+04	8.010555e+03

In [82]:
```
plt.figure(figsize=(10,10),dpi=100)
plt.subplot(2,2,1)
sns.barplot(x="day",y="Q-P1",data=week_t,edgecolor="black",estimator=sum)
plt.xticks(rotation=45);
plt.subplot(2,2,2)
sns.barplot(x="day",y="Q-P2",data=week_t,edgecolor="black",estimator=sum)
plt.xticks(rotation=45);
plt.subplot(2,2,3)
sns.barplot(x="day",y="Q-P3",data=week_t,edgecolor="black",estimator=sum)
plt.xticks(rotation=45);
plt.subplot(2,2,4)
sns.barplot(x="day",y="Q-P4",data=week_t,edgecolor="black",estimator=sum)
```

```
plt.xticks(rotation=45)
plt.subplots_adjust(hspace=0.5);
```



In [83]:
```
plt.figure(figsize=(10,10),dpi=100)
plt.subplot(2,2,1)
sns.barplot(x="day",y="Q-P1",data=weekend_t,edgecolor="black",estimator=sum)
plt.xticks(rotation=45);
plt.subplot(2,2,2)
sns.barplot(x="day",y="Q-P2",data=weekend_t,edgecolor="black",estimator=sum)
plt.xticks(rotation=45);
plt.subplot(2,2,3)
sns.barplot(x="day",y="Q-P3",data=weekend_t,edgecolor="black",estimator=sum)
plt.xticks(rotation=45);
plt.subplot(2,2,4)
sns.barplot(x="day",y="Q-P4",data=weekend_t,edgecolor="black",estimator=sum)
plt.xticks(rotation=45)
plt.subplots_adjust(hspace=0.5);
```



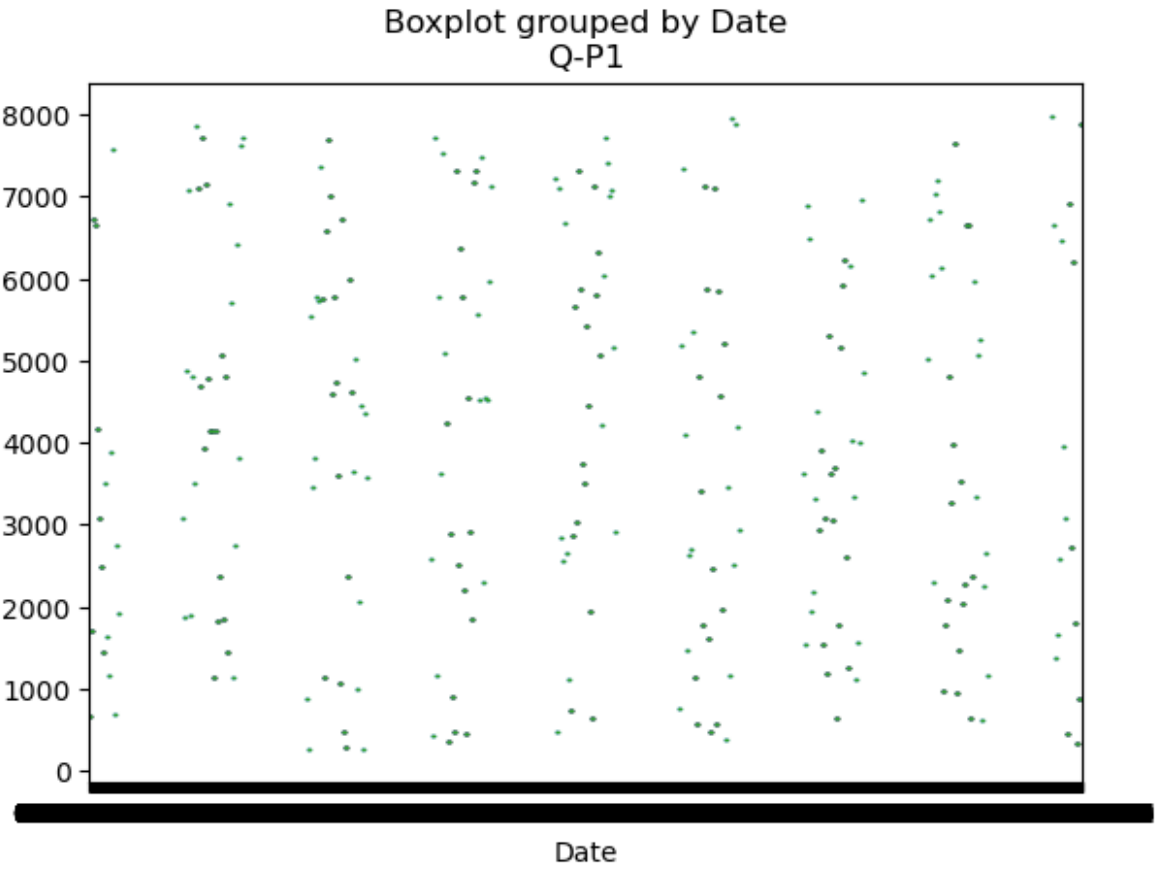
In [27]:
```
data.head()
```

Out[27]:

	Date	Q-P1	Q-P2	Q-P3	Q-P4	S-P1	S-P2	S-P3	S-P4	Day	Month	Year
0	13-06-2010	5422	3725	576	907	17187.74	23616.50	3121.92	6466.91	13	06	2010
1	14-06-2010	7047	779	3578	1574	22338.99	4938.86	19392.76	11222.62	14	06	2010
2	15-06-2010	1572	2082	595	1145	4983.24	13199.88	3224.90	8163.85	15	06	2010
3	16-06-2010	5657	2399	3140	1672	17932.69	15209.66	17018.80	11921.36	16	06	2010
4	17-06-2010	3668	3207	2184	708	11627.56	20332.38	11837.28	5048.04	17	06	2010

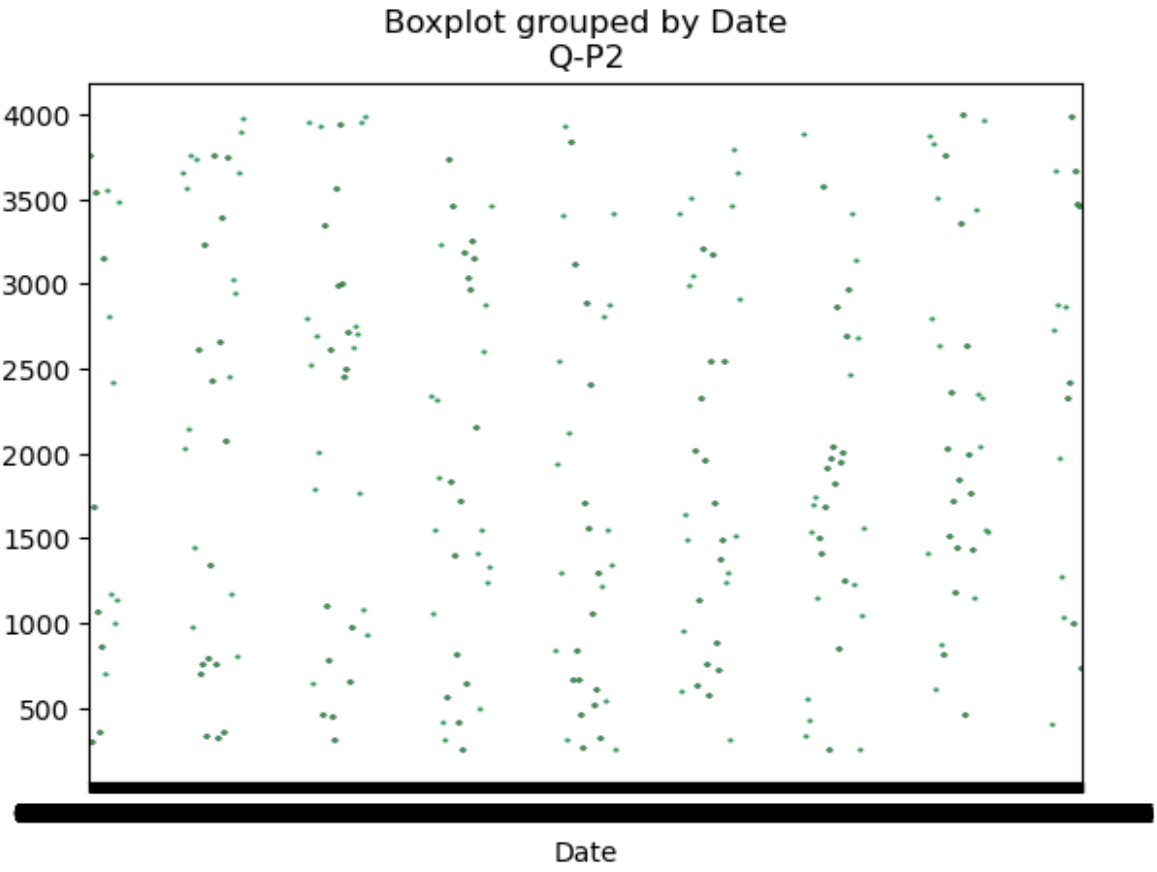
In [29]:
```
data.boxplot(by ='Date', column =['Q-P1'], grid = False)
```

Out[29]:
```
<AxesSubplot:title={'center':'Q-P1'}, xlabel='Date'>
```



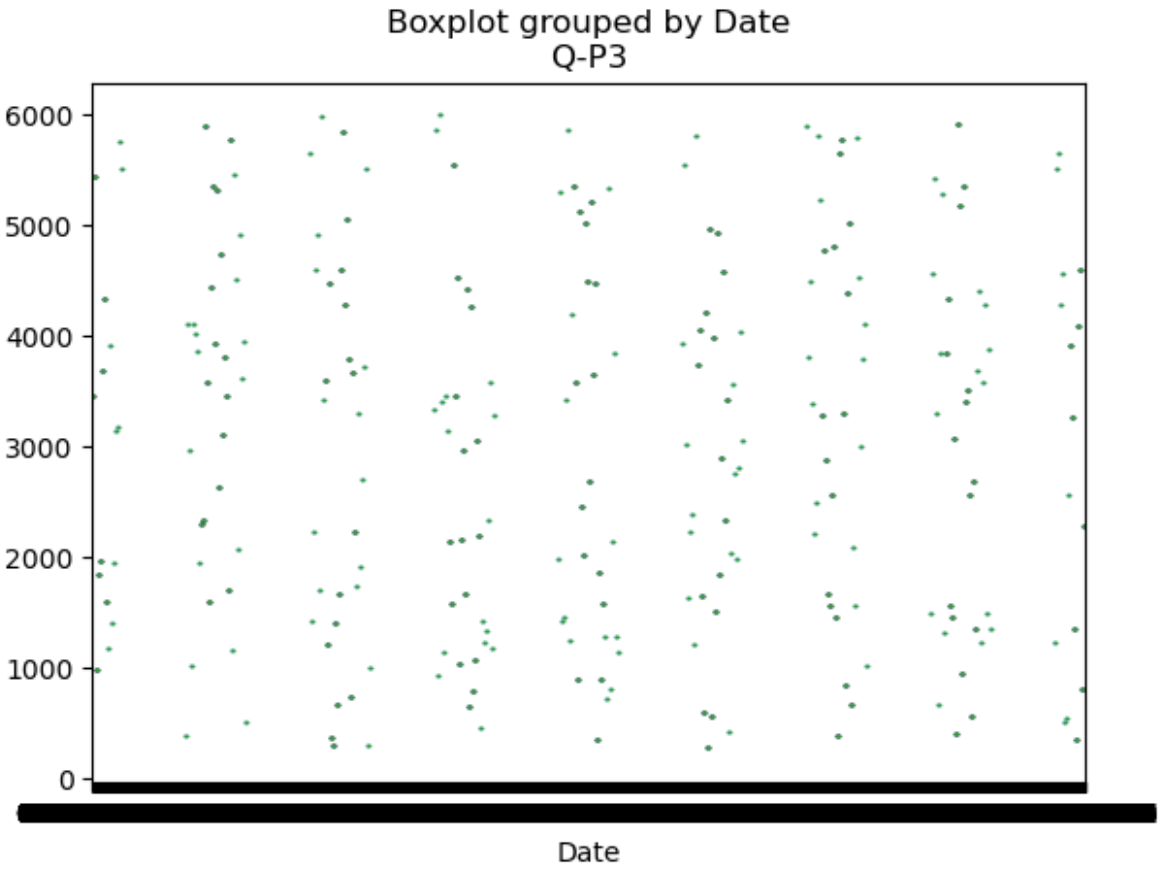
In [30]:
```
data.boxplot(by ='Date', column =['Q-P2'], grid = False)
```

Out[30]:
```
<AxesSubplot:title={'center':'Q-P2'}, xlabel='Date'>
```



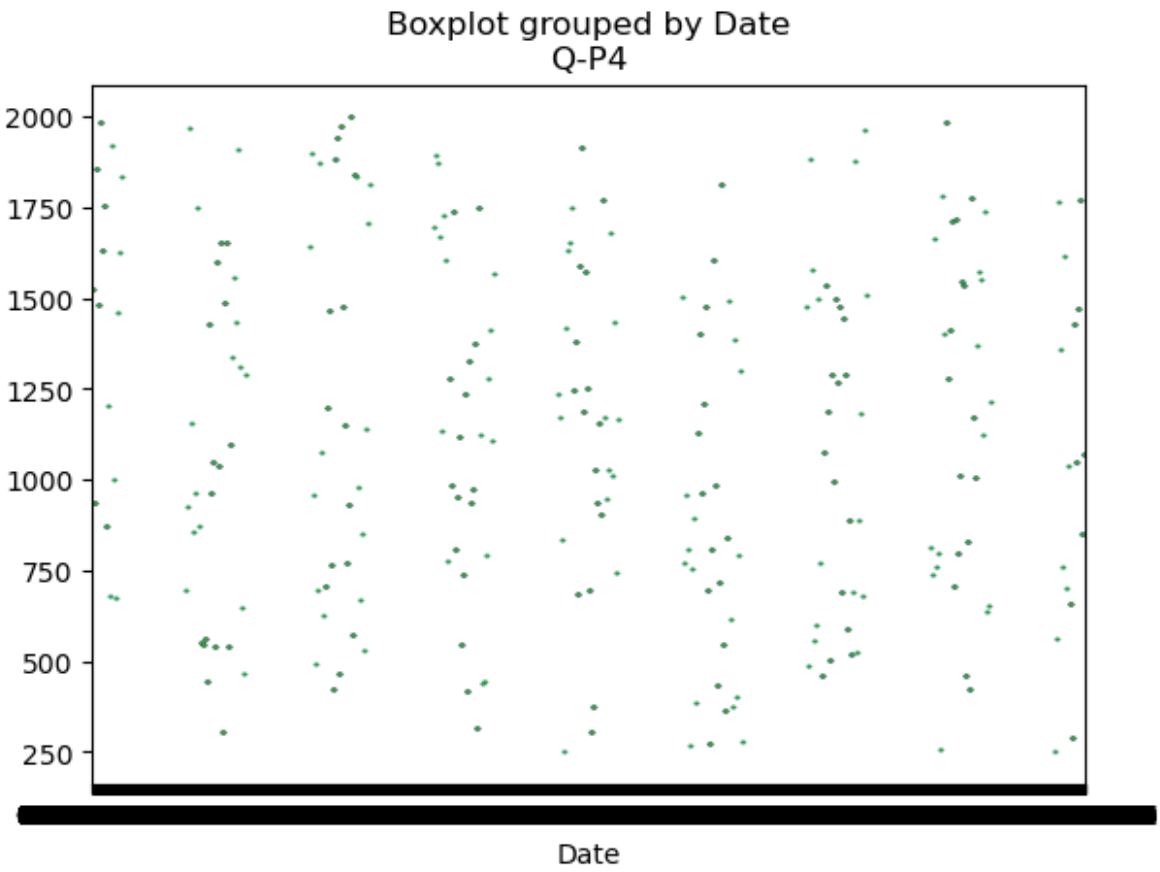
In [31]:
```
data.boxplot(by ='Date', column =['Q-P3'], grid = False)
```

Out[31]:
```
<AxesSubplot:title={'center':'Q-P3'}, xlabel='Date'>
```



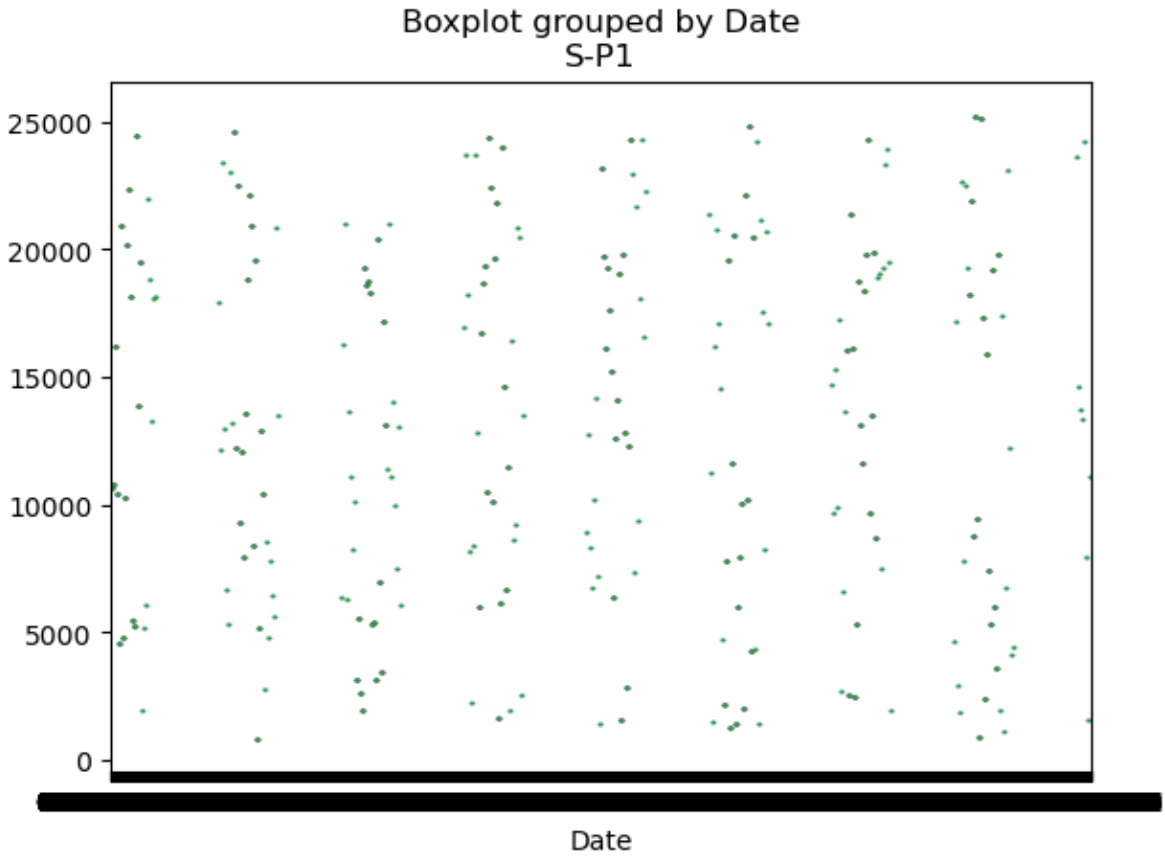
In [32]:
```
data.boxplot(by ='Date', column =['Q-P4'], grid = False)
```

Out[32]:
```
<AxesSubplot:title={'center':'Q-P4'}, xlabel='Date'>
```



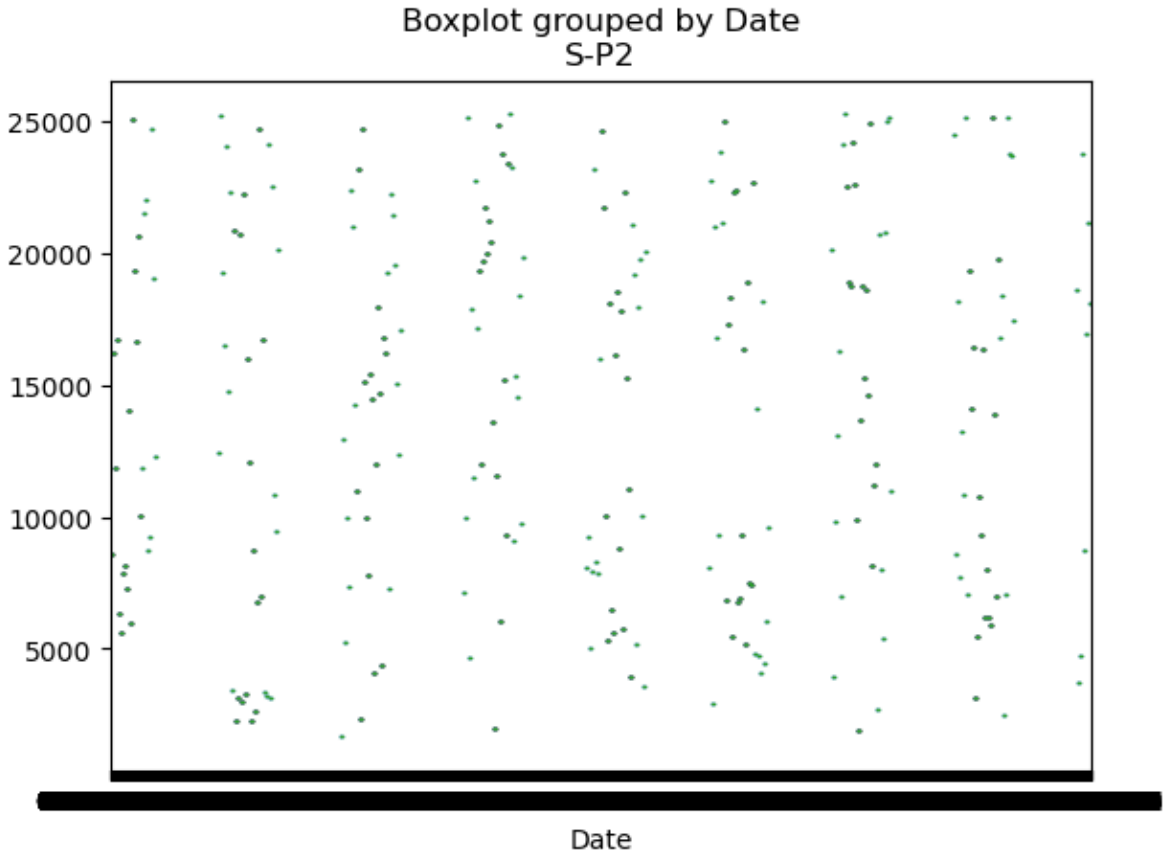
In [33]:
```
data.boxplot(by ='Date', column =['S-P1'], grid = False)
```

Out[33]:
```
<AxesSubplot:title={'center':'S-P1'}, xlabel='Date'>
```



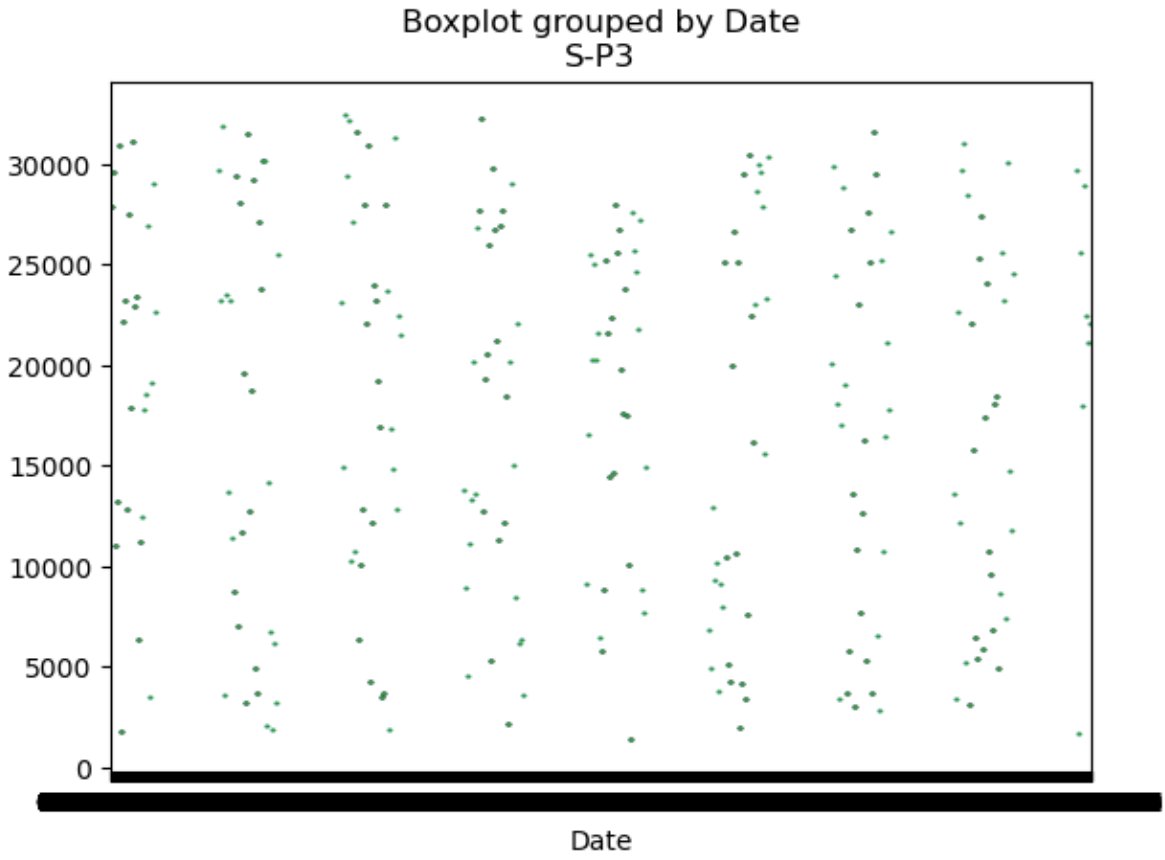
In [35]:
```
data.boxplot(by ='Date', column =['S-P2'], grid = False)
```

Out[35]:
```
<AxesSubplot:title={'center':'S-P2'}, xlabel='Date'>
```



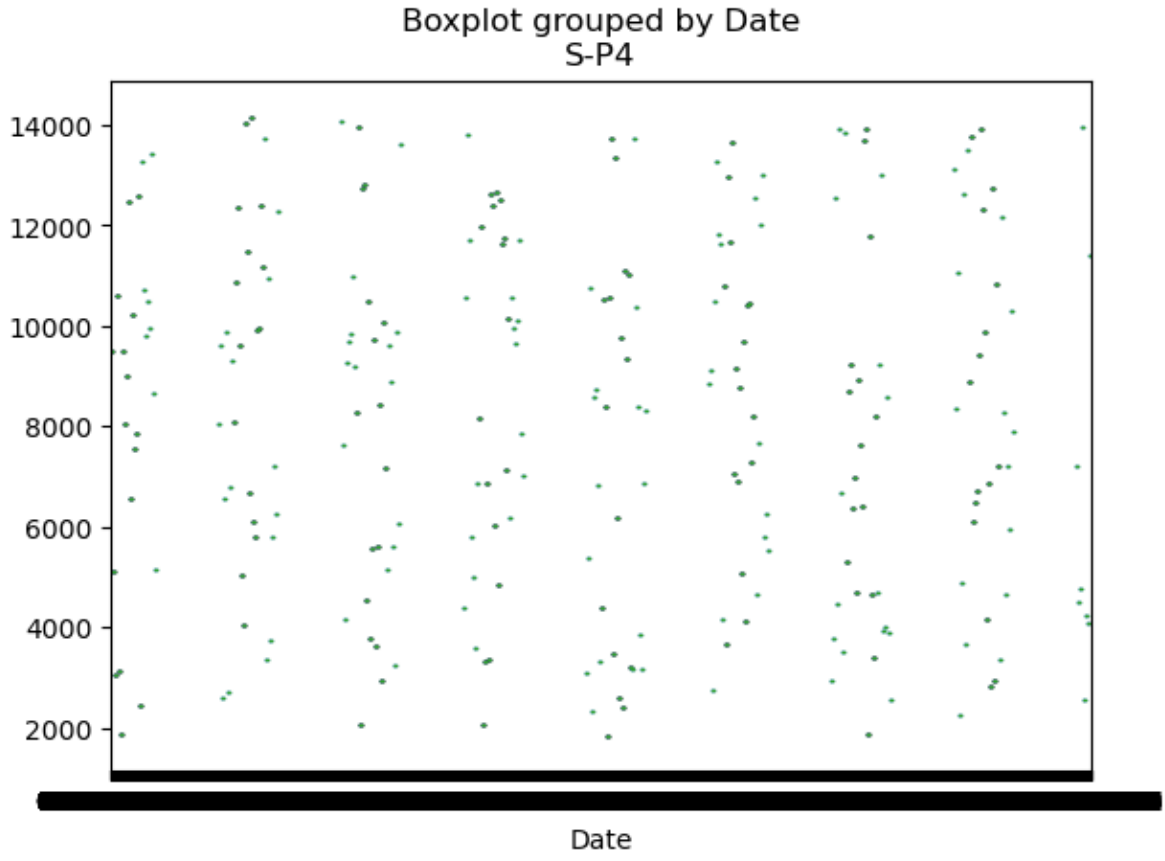
In [37]:
```
data.boxplot(by ='Date', column =['S-P3'], grid = False)
```

Out[37]:
```
<AxesSubplot:title={'center':'S-P3'}, xlabel='Date'>
```



In [38]:
```
data.boxplot(by ='Date', column =['S-P4'], grid = False)
```

Out[38]:
```
<AxesSubplot:title={'center':'S-P4'}, xlabel='Date'>
```



In [56]:
```
 fig, axes = plt.subplots()
axes.stem(data['Date'], data['S-P1'], use_line_collection=True, basefmt=' ')
axes.set_ylim(10)
plt.title('Data')
plt.xlabel('Month')
plt.ylabel('Date')
plt.xticks(data['Q-P1'])
```

Out[56]:
```
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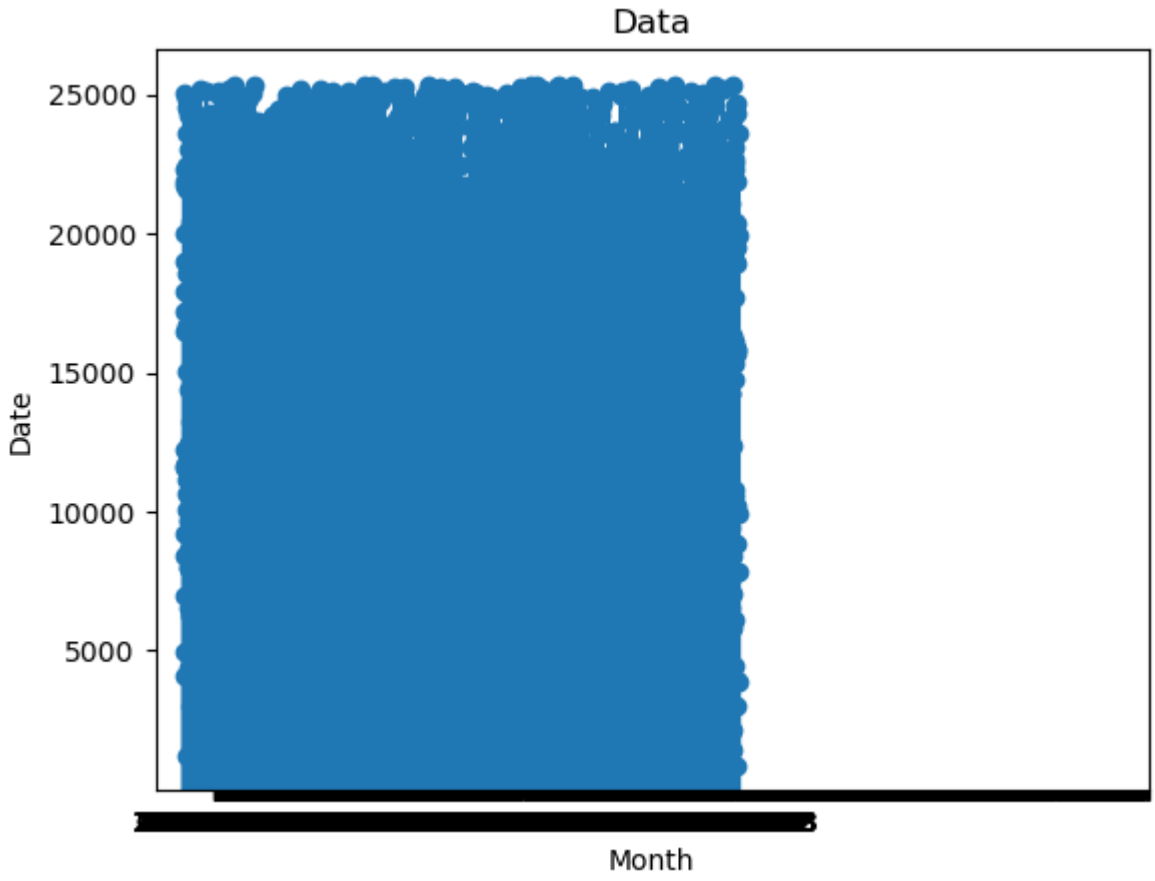

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