Introduction:

The purpose of this project is to investigate how the entry of Chobani in 2007 influenced the sales of Yoplait yoghurt. We have national-level weekly data on (1) total unit sales of Yoplait products, (2) average unit price of Yoplait products, (3) average unit price of Dannon products,which is a substitute for Yoplait yoghurt, and (4) average unit price of Chobani products between 2001 and 2011.

Our analysis includes plotting the data to observe patterns. We also estimate a linear demand curve for Yoplait. Finally, we compute weekly price elasticities of Yoplait demand (own- and two cross-price elasticities) to draw inference about competitive structure, particularly whether the price elasticities changed as a result of Chobani's entry.

In [1]:
```python
import pandas as pd
import numpy as np
%matplotlib inline
import statsmodels.formula.api as smf
import matplotlib.pyplot as plt
df=pd.read_excel('yogurt1.xls')
df
```

Out[1]:

	WEEK	MONTH	YOPLAIT UNITS	YOPLAIT PRICE	DANNON PRICE	CHOBANI PRICE	LN(WEEK)	Jan	Feb	Mar	Apr
0	1	Jan	1431790	0.76	1.04	0.00	0.000000	1	0	0	0
1	2	Jan	1549503	0.80	0.94	0.00	0.693147	1	0	0	0
2	3	Jan	1448646	0.83	1.02	0.00	1.098612	1	0	0	0
3	4	Jan	1398011	0.82	1.10	0.00	1.386294	1	0	0	0
4	5	Feb	1525899	0.81	1.10	0.00	1.609438	0	1	0	0
5	6	Feb	1315745	0.87	0.89	0.00	1.791759	0	1	0	0
6	7	Feb	1247943	0.87	1.00	0.00	1.945910	0	1	0	0
7	8	Feb	1206063	0.89	1.06	0.00	2.079442	0	1	0	0
8	9	Mar	1541804	0.85	1.11	0.00	2.197225	0	0	1	0
9	10	Mar	1493644	0.83	1.11	0.00	2.302585	0	0	1	0
10	11	Mar	1355595	0.87	0.93	0.00	2.397895	0	0	1	0
11	12	Mar	1309235	0.91	1.09	0.00	2.484907	0	0	1	0
12	13	Mar	1370437	0.87	1.11	0.00	2.564949	0	0	1	0
13	14	Apr	1498930	0.84	1.02	0.00	2.639057	0	0	0	1
14	15	Apr	1321056	0.89	1.10	0.00	2.708050	0	0	0	1
15	16	Apr	1203680	0.87	0.97	0.00	2.772589	0	0	0	1
16	17	Apr	1236598	0.94	0.94	0.00	2.833213	0	0	0	1
17	18	May	1493550	0.88	1.11	0.00	2.890372	0	0	0	0
18	19	May	1262692	0.95	1.02	0.00	2.944439	0	0	0	0
19	20	May	1365748	0.87	0.93	0.00	2.995732	0	0	0	0
20	21	May	1283943	0.92	1.08	0.00	3.044522	0	0	0	0
21	22	May	1373136	0.86	1.03	0.00	3.091042	0	0	0	0
22	23	Jun	1550108	0.84	0.94	0.00	3.135494	0	0	0	0
23	24	Jun	1411876	0.84	1.06	0.00	3.178054	0	0	0	0
24	25	Jun	1277361	0.87	0.99	0.00	3.218876	0	0	0	0
25	26	Jun	1158561	0.91	1.05	0.00	3.258097	0	0	0	0
26	27	Jul	1259457	0.88	1.09	0.00	3.295837	0	0	0	0
27	28	Jul	1175128	0.92	0.96	0.00	3.332205	0	0	0	0
28	29	Jul	1310654	0.87	1.04	0.00	3.367296	0	0	0	0
29	30	Jul	1264448	0.88	1.10	0.00	3.401197	0	0	0	0
...	...	...	...	...	...	...	...	...	...	...	...
543	544	Jun	1903941	0.85	1.56	1.40	6.298949	0	0	0	0
544	545	Jun	1654621	0.97	1.54	1.39	6.300786	0	0	0	0
545	546	Jun	1737019	0.93	1.42	1.40	6.302619	0	0	0	0
546	547	Jun	1759658	0.91	1.66	1.40	6.304449	0	0	0	0

	WEEK	MONTH	YOPLAIT UNITS	YOPLAIT PRICE	DANNON PRICE	CHOBANI PRICE	LN(WEEK)	Jan	Feb	Mar	Apr
547	548	Jun	1746264	0.91	1.63	1.41	6.306275	0	0	0	0
548	549	Jul	1615631	0.99	1.54	1.41	6.308098	0	0	0	0
549	550	Jul	1851221	0.93	1.60	1.40	6.309918	0	0	0	0
550	551	Jul	1898320	0.89	1.61	1.41	6.311735	0	0	0	0
551	552	Jul	1509453	0.99	1.50	1.39	6.313548	0	0	0	0
552	553	Aug	1879026	0.95	1.65	1.28	6.315358	0	0	0	0
553	554	Aug	2025709	0.97	1.58	1.37	6.317165	0	0	0	0
554	555	Aug	1867477	0.95	1.65	1.38	6.318968	0	0	0	0
555	556	Aug	1594002	1.03	1.65	1.23	6.320768	0	0	0	0
556	557	Sep	1613750	1.02	1.63	1.37	6.322565	0	0	0	0
557	558	Sep	2032965	0.95	1.61	1.33	6.324359	0	0	0	0
558	559	Sep	1745274	1.06	1.64	1.41	6.326149	0	0	0	0
559	560	Sep	1679836	1.03	1.67	1.36	6.327937	0	0	0	0
560	561	Sep	1792941	0.99	1.71	1.36	6.329721	0	0	0	0
561	562	Oct	1890071	0.97	1.64	1.29	6.331502	0	0	0	0
562	563	Oct	1854960	0.99	1.73	1.24	6.333280	0	0	0	0
563	564	Oct	1681291	1.00	1.68	1.32	6.335054	0	0	0	0
564	565	Oct	1570368	0.99	1.78	1.31	6.336826	0	0	0	0
565	566	Nov	1570216	1.00	1.76	1.21	6.338594	0	0	0	0
566	567	Nov	1737014	0.97	1.86	1.30	6.340359	0	0	0	0
567	568	Nov	1428985	1.06	1.75	1.31	6.342121	0	0	0	0
568	569	Nov	1076198	1.10	1.77	1.38	6.343880	0	0	0	0
569	570	Dec	1523707	1.00	1.83	1.31	6.345636	0	0	0	0
570	571	Dec	1579472	1.00	1.88	1.28	6.347389	0	0	0	0
571	572	Dec	1223610	1.07	1.85	1.25	6.349139	0	0	0	0
572	573	Dec	1092610	1.04	1.90	1.40	6.350886	0	0	0	0

573 rows × 18 columns

Graphical Analysis

```
In [2]: df1=df.iloc[:,[0,2,3,4,5,]]
        df1
        A1=df1.iloc[:,[0,1]]
        A2=df1.iloc[:,[0,2]]
        A3=df1.iloc[:,[0,3]]
        A4=df1.iloc[:,[0,4]]
```

In [3]:
```python
#fig, ax =plt.subplots()
plt.plot(A2["WEEK"],A2["YOPLAIT PRICE"],color="r",linewidth = 1)
plt.plot(A3["WEEK"],A3["DANNON PRICE"],color="g",linewidth = 1)
plt.plot(A4["WEEK"],A4["CHOBANI PRICE"],color="m",linewidth = 1)
plt.ylim(0,2.50)
plt.title("Price change over time for Yogurt Sales")
plt.ylabel("Price($)")
plt.xlabel("Week")
plt.legend(["YOPLAIT PRICE","DANNON PRICE","CHOBANI PRICE"])
plt2=plt.twinx()
plt2.plot(A1["WEEK"],A1["YOPLAIT UNITS"],color="b",linewidth = 0.5,linestyle=
"--")
plt2.set_ylabel("Unit")
plt2.legend(["YOPLAIT SALES"],loc=4)
plt.figure(figsize=(20,10))
```

Out[3]: <Figure size 1440x720 with 0 Axes>

<Figure size 1440x720 with 0 Axes>
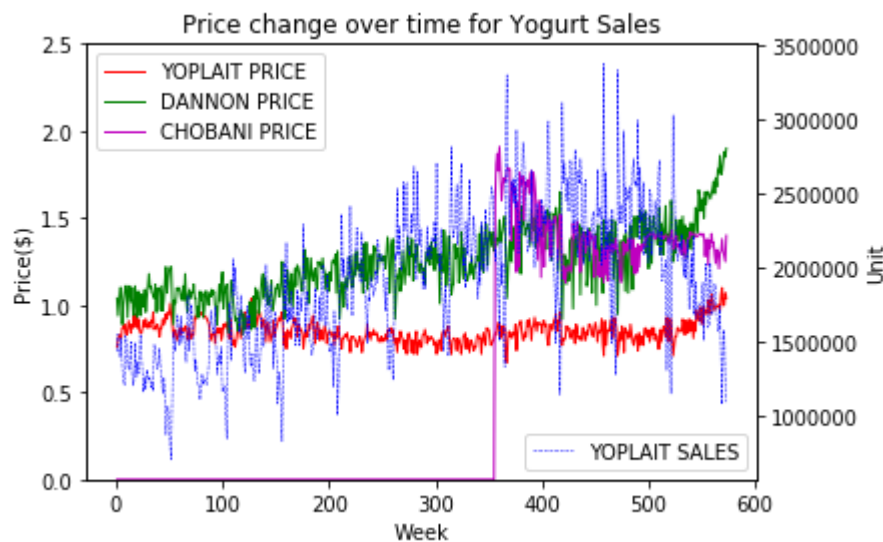
Observations from above graph:

- 1. Yoplait sales increase until around week 400 and then fluctuate over time. After week 500,Yoplait sales starts to decrease.
- 1. Yoplait sales exhibit seasonality.
- 1. When Chobani enters the market at around week 350, it set the price higher than Yoplait's and Dannon's price. But the price then decrease immediately to around 1.2 dollars and was maintained at a similar level with fluctuation.
- 1. Yoplait's price is relatively stable until around week 500. Then its price starts to increase.
- 1. In contrast, Dannon's price increased to around week 400. Then its price decreased when Chobani cut off the price, and increased again more sharply after around week 500.

These observation could be interpreted as follows:

- 1. The decrease of Yoplait sales after week 500 might be affected by the increase of its sales price.
- 1. The decrease of Yoplait sales could also related to the Chobani's price decrease. When Chobani entered the market, its sales price was set too high above others to compete with Yoplait and Dannon due to the customers' brand loyalty. Then the price was cutted off strategically around week 400 to attract customers that used to purchase products of Yoplait. This could be verified that at that time, Yoplait sales also started to decrease.
- 1. The sharp increase of Dannon's price is the reaction to the increase of Yoplait's price after week 500.

In [4]:
```python
df=df.rename(columns={df.columns[2]: "YOPLAIT_UNITS",df.columns[3]: "YOPLAIT_P
RICE",
                      df.columns[4]: "DANNON_PRICE",df.columns[5]: "CHOBANI_PR
ICE",df.columns[6]: "LNWEEK" })
df
```

Out[4]:

	WEEK	MONTH	YOPLAIT_UNITS	YOPLAIT_PRICE	DANNON_PRICE	CHOBANI_PRICE	LNW
0	1	Jan	1431790	0.76	1.04	0.00	0.00
1	2	Jan	1549503	0.80	0.94	0.00	0.69
2	3	Jan	1448646	0.83	1.02	0.00	1.09
3	4	Jan	1398011	0.82	1.10	0.00	1.38
4	5	Feb	1525899	0.81	1.10	0.00	1.60
5	6	Feb	1315745	0.87	0.89	0.00	1.79
6	7	Feb	1247943	0.87	1.00	0.00	1.94
7	8	Feb	1206063	0.89	1.06	0.00	2.07
8	9	Mar	1541804	0.85	1.11	0.00	2.19
9	10	Mar	1493644	0.83	1.11	0.00	2.30
10	11	Mar	1355595	0.87	0.93	0.00	2.39
11	12	Mar	1309235	0.91	1.09	0.00	2.48
12	13	Mar	1370437	0.87	1.11	0.00	2.56
13	14	Apr	1498930	0.84	1.02	0.00	2.63
14	15	Apr	1321056	0.89	1.10	0.00	2.70
15	16	Apr	1203680	0.87	0.97	0.00	2.77
16	17	Apr	1236598	0.94	0.94	0.00	2.83
17	18	May	1493550	0.88	1.11	0.00	2.89
18	19	May	1262692	0.95	1.02	0.00	2.94
19	20	May	1365748	0.87	0.93	0.00	2.99
20	21	May	1283943	0.92	1.08	0.00	3.04
21	22	May	1373136	0.86	1.03	0.00	3.09
22	23	Jun	1550108	0.84	0.94	0.00	3.13
23	24	Jun	1411876	0.84	1.06	0.00	3.17
24	25	Jun	1277361	0.87	0.99	0.00	3.21
25	26	Jun	1158561	0.91	1.05	0.00	3.25
26	27	Jul	1259457	0.88	1.09	0.00	3.29
27	28	Jul	1175128	0.92	0.96	0.00	3.33
28	29	Jul	1310654	0.87	1.04	0.00	3.36
29	30	Jul	1264448	0.88	1.10	0.00	3.40
...	...	...	...	...	...	...	
543	544	Jun	1903941	0.85	1.56	1.40	6.29
544	545	Jun	1654621	0.97	1.54	1.39	6.30
545	546	Jun	1737019	0.93	1.42	1.40	6.30
546	547	Jun	1759658	0.91	1.66	1.40	6.30

	WEEK	MONTH	YOPLAIT_UNITS	YOPLAIT_PRICE	DANNON_PRICE	CHOBANI_PRICE	LNW
547	548	Jun	1746264	0.91	1.63	1.41	6.30
548	549	Jul	1615631	0.99	1.54	1.41	6.30
549	550	Jul	1851221	0.93	1.60	1.40	6.30
550	551	Jul	1898320	0.89	1.61	1.41	6.31
551	552	Jul	1509453	0.99	1.50	1.39	6.31
552	553	Aug	1879026	0.95	1.65	1.28	6.31
553	554	Aug	2025709	0.97	1.58	1.37	6.31
554	555	Aug	1867477	0.95	1.65	1.38	6.31
555	556	Aug	1594002	1.03	1.65	1.23	6.32
556	557	Sep	1613750	1.02	1.63	1.37	6.32
557	558	Sep	2032965	0.95	1.61	1.33	6.32
558	559	Sep	1745274	1.06	1.64	1.41	6.32
559	560	Sep	1679836	1.03	1.67	1.36	6.32
560	561	Sep	1792941	0.99	1.71	1.36	6.32
561	562	Oct	1890071	0.97	1.64	1.29	6.33
562	563	Oct	1854960	0.99	1.73	1.24	6.33
563	564	Oct	1681291	1.00	1.68	1.32	6.33
564	565	Oct	1570368	0.99	1.78	1.31	6.33
565	566	Nov	1570216	1.00	1.76	1.21	6.33
566	567	Nov	1737014	0.97	1.86	1.30	6.34
567	568	Nov	1428985	1.06	1.75	1.31	6.34
568	569	Nov	1076198	1.10	1.77	1.38	6.34
569	570	Dec	1523707	1.00	1.83	1.31	6.34
570	571	Dec	1579472	1.00	1.88	1.28	6.34
571	572	Dec	1223610	1.07	1.85	1.25	6.34
572	573	Dec	1092610	1.04	1.90	1.40	6.35

573 rows × 18 columns

Demand Curve Estimation

We conduct regression analysis using the entire data and estimate a linear demand for Yoplait products. We include the following three set of variables as Independent Variables:

(1) three prices

(2) time trend (natural log of the variable WEEK, i.e., ln(WEEK))

(3) monthly dummies

Inclusion of three prices allows us to investigate own- and cross-price elasticities. Time trend and monthly dummies are important for capturing the variation in sales not due to price changes.

```
In [5]: reg_all=smf.ols("YOPLAIT_UNITS~YOPLAIT_PRICE+DANNON_PRICE+CHOBANI_PRICE+LNWEEK
        +Jan+Feb+Mar+Apr+May+Jun+Jul+Aug+Sep+Oct+Nov",data=df).fit()
        print(reg_all.summary())
```

OLS Regression Results

```
=================================================================
=
Dep. Variable:          YOPLAIT_UNITS   R-squared:                    0.87
6
Model:                            OLS   Adj. R-squared:               0.87
3
Method:                 Least Squares   F-statistic:                  262.
0
Date:               Tue, 14 May 2019   Prob (F-statistic):        8.50e-24
1
Time:                        14:02:56   Log-Likelihood:             -7698.
2
No. Observations:                 573   AIC:                       1.543e+0
4
Df Residuals:                     557   BIC:                       1.550e+0
4
Df Model:                          15
Covariance Type:            nonrobust
=================================================================
====
                     coef     std err          t      P>|t|      [0.025      0.
975]
-----------------------------------------------------------------
----
Intercept         4.126e+06    1.43e+05     28.858      0.000     3.85e+06     4.41
e+06
YOPLAIT_PRICE    -4.307e+06    1.27e+05    -34.036      0.000    -4.56e+06    -4.06
e+06
DANNON_PRICE      8.058e+04    5.42e+04      1.486      0.138     -2.6e+04     1.87
e+05
CHOBANI_PRICE     2.559e+05     1.5e+04     17.008      0.000     2.26e+05     2.85
e+05
LNWEEK            1.573e+05    1.04e+04     15.067      0.000     1.37e+05     1.78
e+05
Jan               4.168e+05    3.75e+04     11.109      0.000     3.43e+05      4.9
e+05
Feb               4.577e+05    3.67e+04     12.487      0.000     3.86e+05      5.3
e+05
Mar               4.763e+05     3.5e+04     13.593      0.000     4.07e+05     5.45
e+05
Apr               4.261e+05    3.53e+04     12.074      0.000     3.57e+05     4.95
e+05
May               4.201e+05    3.51e+04     11.978      0.000     3.51e+05     4.89
e+05
Jun                3.64e+05     3.5e+04     10.397      0.000     2.95e+05     4.33
e+05
Jul               3.434e+05    3.43e+04     10.014      0.000     2.76e+05     4.11
e+05
Aug               4.066e+05    3.44e+04     11.819      0.000     3.39e+05     4.74
e+05
Sep               4.536e+05    3.45e+04     13.150      0.000     3.86e+05     5.21
e+05
Oct               3.495e+05    3.51e+04      9.964      0.000     2.81e+05     4.18
e+05
Nov                1.39e+05    3.45e+04      4.032      0.000     7.13e+04     2.07
e+05
```

```
================================================================================
=
Omnibus:                        6.978    Durbin-Watson:                     0.93
9
Prob(Omnibus):                  0.031    Jarque-Bera (JB):                 10.09
3
Skew:                          -0.022    Prob(JB):                        0.0064
3
Kurtosis:                       3.649    Cond. No.                            15
5.
================================================================================
=

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correc
tly specified.
```

In [6]:
```python
from sklearn.linear_model import LinearRegression
y = df.iloc[:,2]
X = df.iloc[:,3:]
```

In [7]:
```python
reg = LinearRegression().fit(X, y)
intercept = reg.intercept_

print('Estimated intercept coefficient:', intercept)
```

Estimated intercept coefficient: 4126408.170070924

In [8]:
```python
vari = X.columns.values.tolist()
vari.insert(0, 'Intercept')
Para_Est = pd.DataFrame(list(zip(vari, reg_all.params, reg_all.bse)), columns
= ['Variables', 'Estimated Coefficients', 'Standard Error'])
Para_Est
```

Out[8]:

	Variables	Estimated Coefficients	Standard Error
0	Intercept	4.126408e+06	142989.818025
1	YOPLAIT_PRICE	-4.306898e+06	126539.055097
2	DANNON_PRICE	8.058438e+04	54246.841616
3	CHOBANI_PRICE	2.558855e+05	15045.131681
4	LNWEEK	1.573041e+05	10440.104876
5	Jan	4.167889e+05	37517.068886
6	Feb	4.577361e+05	36657.886979
7	Mar	4.763211e+05	35042.897995
8	Apr	4.260627e+05	35287.490489
9	May	4.200777e+05	35071.836010
10	Jun	3.639905e+05	35009.255878
11	Jul	3.433866e+05	34289.483761
12	Aug	4.065518e+05	34396.814839
13	Sep	4.535511e+05	34490.366778
14	Oct	3.494667e+05	35071.951795
15	Nov	1.390423e+05	34487.120350

Regression Analysis:

- The linear demand is estiamted as the format:

  ```
  Yoplait units sales= b0 + b1 * Yoplait Price + b2 * Dannon Price+ b3 * Choban
  i Price + b4 * Lnweek + … + b15 * Nov
  ```

- With the help of regression calculation tool, the estimated regression function is finally determined as:

  ```
  Yoplait units sales= 4126408 -4306898 * Yoplait Price + 80584.38 * Dannon Pr
  ice + 255885.5 * Chobani Price
     + 157304.1 * LnWeek + 416788.9 * Jan + 457736.1 * Feb + 476321.1 * Mar + 426
  062.7 * Apr + 420077.7 * May
     + 363990.5 * Jun + 343386.6 * Jul + 406551.8 * Aug + 453551.1 * Sep + 34946
  6.7 * Oct + 139042.3 * Nov
  ```

- The results seem to be consistent with theory: The Yoplait price has a negative effect on Yoplait's sales, while the price of Dannon and Chobani has a positive effect on Yoplait's sales. The time also influence the sales positively. All the coefficients except Dannon Price are significant. The adjusted R squared value is pretty high at 87%, indicating high goodness of fit.

```
In [9]:  Month = Para_Est.iloc[5:16,0:2]
         Month.columns = ['MONTH','Monthly Dummy Effects']
         Month.loc[-1] = ['Dec',0]
         Month
```

Out[9]:

	MONTH	Monthly Dummy Effects
5	Jan	416788.905078
6	Feb	457736.148745
7	Mar	476321.069384
8	Apr	426062.711488
9	May	420077.724684
10	Jun	363990.520966
11	Jul	343386.604344
12	Aug	406551.827621
13	Sep	453551.117530
14	Oct	349466.722548
15	Nov	139042.340772
-1	Dec	0.000000

In [10]:
```python
newdf = df.merge(Month,on='MONTH',how='left')
newdf
#Add 'Monthly Dummy Effects'
```

Out[10]:

	WEEK	MONTH	YOPLAIT_UNITS	YOPLAIT_PRICE	DANNON_PRICE	CHOBANI_PRICE	LNW
0	1	Jan	1431790	0.76	1.04	0.00	0.00
1	2	Jan	1549503	0.80	0.94	0.00	0.69
2	3	Jan	1448646	0.83	1.02	0.00	1.09
3	4	Jan	1398011	0.82	1.10	0.00	1.38
4	5	Feb	1525899	0.81	1.10	0.00	1.60
5	6	Feb	1315745	0.87	0.89	0.00	1.79
6	7	Feb	1247943	0.87	1.00	0.00	1.94
7	8	Feb	1206063	0.89	1.06	0.00	2.07
8	9	Mar	1541804	0.85	1.11	0.00	2.19
9	10	Mar	1493644	0.83	1.11	0.00	2.30
10	11	Mar	1355595	0.87	0.93	0.00	2.39
11	12	Mar	1309235	0.91	1.09	0.00	2.48
12	13	Mar	1370437	0.87	1.11	0.00	2.56
13	14	Apr	1498930	0.84	1.02	0.00	2.63
14	15	Apr	1321056	0.89	1.10	0.00	2.70
15	16	Apr	1203680	0.87	0.97	0.00	2.77
16	17	Apr	1236598	0.94	0.94	0.00	2.83
17	18	May	1493550	0.88	1.11	0.00	2.89
18	19	May	1262692	0.95	1.02	0.00	2.94
19	20	May	1365748	0.87	0.93	0.00	2.99
20	21	May	1283943	0.92	1.08	0.00	3.04
21	22	May	1373136	0.86	1.03	0.00	3.09
22	23	Jun	1550108	0.84	0.94	0.00	3.13
23	24	Jun	1411876	0.84	1.06	0.00	3.17
24	25	Jun	1277361	0.87	0.99	0.00	3.21
25	26	Jun	1158561	0.91	1.05	0.00	3.25
26	27	Jul	1259457	0.88	1.09	0.00	3.29
27	28	Jul	1175128	0.92	0.96	0.00	3.33
28	29	Jul	1310654	0.87	1.04	0.00	3.36
29	30	Jul	1264448	0.88	1.10	0.00	3.40
...	...	...	...	...	...	...	
543	544	Jun	1903941	0.85	1.56	1.40	6.29
544	545	Jun	1654621	0.97	1.54	1.39	6.30
545	546	Jun	1737019	0.93	1.42	1.40	6.30

	WEEK	MONTH	YOPLAIT_UNITS	YOPLAIT_PRICE	DANNON_PRICE	CHOBANI_PRICE	LNW
546	547	Jun	1759658	0.91	1.66	1.40	6.30
547	548	Jun	1746264	0.91	1.63	1.41	6.30
548	549	Jul	1615631	0.99	1.54	1.41	6.30
549	550	Jul	1851221	0.93	1.60	1.40	6.30
550	551	Jul	1898320	0.89	1.61	1.41	6.31
551	552	Jul	1509453	0.99	1.50	1.39	6.31
552	553	Aug	1879026	0.95	1.65	1.28	6.31
553	554	Aug	2025709	0.97	1.58	1.37	6.31
554	555	Aug	1867477	0.95	1.65	1.38	6.31
555	556	Aug	1594002	1.03	1.65	1.23	6.32
556	557	Sep	1613750	1.02	1.63	1.37	6.32
557	558	Sep	2032965	0.95	1.61	1.33	6.32
558	559	Sep	1745274	1.06	1.64	1.41	6.32
559	560	Sep	1679836	1.03	1.67	1.36	6.32
560	561	Sep	1792941	0.99	1.71	1.36	6.32
561	562	Oct	1890071	0.97	1.64	1.29	6.33
562	563	Oct	1854960	0.99	1.73	1.24	6.33
563	564	Oct	1681291	1.00	1.68	1.32	6.33
564	565	Oct	1570368	0.99	1.78	1.31	6.33
565	566	Nov	1570216	1.00	1.76	1.21	6.33
566	567	Nov	1737014	0.97	1.86	1.30	6.34
567	568	Nov	1428985	1.06	1.75	1.31	6.34
568	569	Nov	1076198	1.10	1.77	1.38	6.34
569	570	Dec	1523707	1.00	1.83	1.31	6.34
570	571	Dec	1579472	1.00	1.88	1.28	6.34
571	572	Dec	1223610	1.07	1.85	1.25	6.34
572	573	Dec	1092610	1.04	1.90	1.40	6.35

573 rows × 19 columns

In [11]:
```python
newdf['PREDICTED YOPLAIT UNITS'] = newdf['Monthly Dummy Effects'] + intercept
+ Para_Est.iloc[1,1] * newdf[
    'YOPLAIT_PRICE'] + Para_Est.iloc[2,1] * newdf['DANNON_PRICE'] + Para_Est.i
loc[3,1] *newdf[
    'CHOBANI_PRICE'] + Para_Est.iloc[4,1] * newdf['LNWEEK']
newdf
#Add 'PREDICTED YOPLAIT UNITS'
```

Out[11]:

	WEEK	MONTH	YOPLAIT_UNITS	YOPLAIT_PRICE	DANNON_PRICE	CHOBANI_PRICE	LNW
0	1	Jan	1431790	0.76	1.04	0.00	0.00
1	2	Jan	1549503	0.80	0.94	0.00	0.69
2	3	Jan	1448646	0.83	1.02	0.00	1.09
3	4	Jan	1398011	0.82	1.10	0.00	1.38
4	5	Feb	1525899	0.81	1.10	0.00	1.60
5	6	Feb	1315745	0.87	0.89	0.00	1.79
6	7	Feb	1247943	0.87	1.00	0.00	1.94
7	8	Feb	1206063	0.89	1.06	0.00	2.07
8	9	Mar	1541804	0.85	1.11	0.00	2.19
9	10	Mar	1493644	0.83	1.11	0.00	2.30
10	11	Mar	1355595	0.87	0.93	0.00	2.39
11	12	Mar	1309235	0.91	1.09	0.00	2.48
12	13	Mar	1370437	0.87	1.11	0.00	2.56
13	14	Apr	1498930	0.84	1.02	0.00	2.63
14	15	Apr	1321056	0.89	1.10	0.00	2.70
15	16	Apr	1203680	0.87	0.97	0.00	2.77
16	17	Apr	1236598	0.94	0.94	0.00	2.83
17	18	May	1493550	0.88	1.11	0.00	2.89
18	19	May	1262692	0.95	1.02	0.00	2.94
19	20	May	1365748	0.87	0.93	0.00	2.99
20	21	May	1283943	0.92	1.08	0.00	3.04
21	22	May	1373136	0.86	1.03	0.00	3.09
22	23	Jun	1550108	0.84	0.94	0.00	3.13
23	24	Jun	1411876	0.84	1.06	0.00	3.17
24	25	Jun	1277361	0.87	0.99	0.00	3.21
25	26	Jun	1158561	0.91	1.05	0.00	3.25
26	27	Jul	1259457	0.88	1.09	0.00	3.29
27	28	Jul	1175128	0.92	0.96	0.00	3.33
28	29	Jul	1310654	0.87	1.04	0.00	3.36
29	30	Jul	1264448	0.88	1.10	0.00	3.40
...	...	...	...	...	...	...	
543	544	Jun	1903941	0.85	1.56	1.40	6.29
544	545	Jun	1654621	0.97	1.54	1.39	6.30
545	546	Jun	1737019	0.93	1.42	1.40	6.30

	WEEK	MONTH	YOPLAIT_UNITS	YOPLAIT_PRICE	DANNON_PRICE	CHOBANI_PRICE	LNW
546	547	Jun	1759658	0.91	1.66	1.40	6.30
547	548	Jun	1746264	0.91	1.63	1.41	6.30
548	549	Jul	1615631	0.99	1.54	1.41	6.30
549	550	Jul	1851221	0.93	1.60	1.40	6.30
550	551	Jul	1898320	0.89	1.61	1.41	6.31
551	552	Jul	1509453	0.99	1.50	1.39	6.31
552	553	Aug	1879026	0.95	1.65	1.28	6.31
553	554	Aug	2025709	0.97	1.58	1.37	6.31
554	555	Aug	1867477	0.95	1.65	1.38	6.31
555	556	Aug	1594002	1.03	1.65	1.23	6.32
556	557	Sep	1613750	1.02	1.63	1.37	6.32
557	558	Sep	2032965	0.95	1.61	1.33	6.32
558	559	Sep	1745274	1.06	1.64	1.41	6.32
559	560	Sep	1679836	1.03	1.67	1.36	6.32
560	561	Sep	1792941	0.99	1.71	1.36	6.32
561	562	Oct	1890071	0.97	1.64	1.29	6.33
562	563	Oct	1854960	0.99	1.73	1.24	6.33
563	564	Oct	1681291	1.00	1.68	1.32	6.33
564	565	Oct	1570368	0.99	1.78	1.31	6.33
565	566	Nov	1570216	1.00	1.76	1.21	6.33
566	567	Nov	1737014	0.97	1.86	1.30	6.34
567	568	Nov	1428985	1.06	1.75	1.31	6.34
568	569	Nov	1076198	1.10	1.77	1.38	6.34
569	570	Dec	1523707	1.00	1.83	1.31	6.34
570	571	Dec	1579472	1.00	1.88	1.28	6.34
571	572	Dec	1223610	1.07	1.85	1.25	6.34
572	573	Dec	1092610	1.04	1.90	1.40	6.35

573 rows × 20 columns

In [12]:
```python
Residual = newdf["YOPLAIT_UNITS"] - newdf["PREDICTED YOPLAIT UNITS"]
res_df = 557 #Based on the regression results
RSE= np.sqrt(np.sum(Residual ** 2/res_df))
RSE #Residual Standard Error
```

Out[12]: 167734.90963009506

```
In [13]:  newdf['95PI_L'] = newdf['PREDICTED YOPLAIT UNITS'] - 2 * RSE
          newdf['95PI_U'] = newdf['PREDICTED YOPLAIT UNITS'] + 2 * RSE
          newdf['MAPE'] = abs(newdf['PREDICTED YOPLAIT UNITS'] - newdf['YOPLAIT_UNITS'])
          /newdf['YOPLAIT_UNITS']
          print("The the average Mean Absolute Percentage Error across 573 weeks was: {}
          ".format(newdf['MAPE'].mean()))
```

The the average Mean Absolute Percentage Error across 573 weeks was: 0.072590
78870634533

```
In [14]:  newdf1=newdf.iloc[:,[0,2,-2,-3,-4]]
          B1=newdf1.iloc[:,[0,1]]
          B2=newdf1.iloc[:,[0,2]]
          B3=newdf1.iloc[:,[0,3]]
          B4=newdf1.iloc[:,[0,4]]
```

```
In [15]:  plt.plot(B1["WEEK"],B1["YOPLAIT_UNITS"],color="b",linewidth = 1)
          plt.plot(B2["WEEK"],B2["95PI_U"],color="purple",linewidth = 1,linestyle=':')
          plt.plot(B3["WEEK"],B3["95PI_L"],color="g",linewidth = 1,linestyle=':')
          plt.plot(B4["WEEK"],B4["PREDICTED YOPLAIT UNITS"],color="r",linewidth = 1)
          plt.title("Observed versus Predicted Yoplait Sales")
          plt.ylabel("UNIT SALES")
          plt.xlabel("Week")
          plt.legend(["YOPLAIT UNITS","95% PI Upper","95% PI Lower","PREDICTED YOPLAIT U
          NITS"])
          plt.figure(figsize=(20,10))
```

Out[15]: <Figure size 1440x720 with 0 Axes>

<Figure size 1440x720 with 0 Axes>
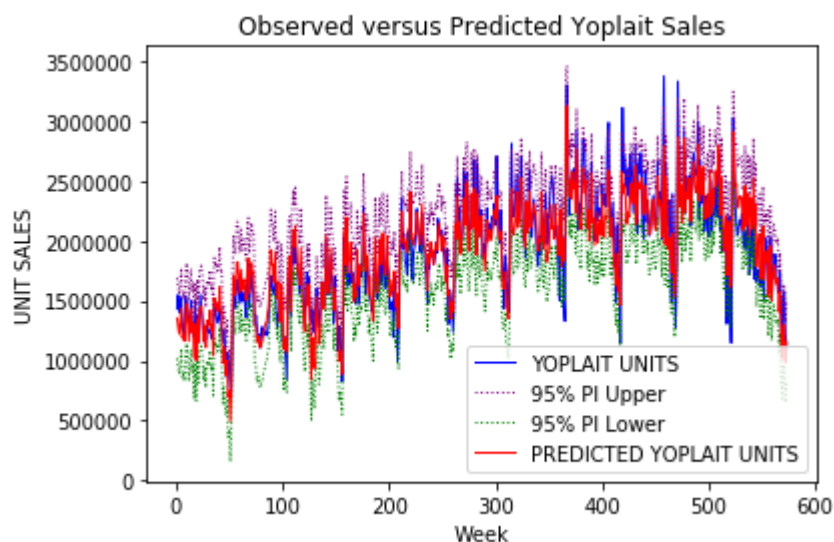
Graphical Analysis and MAPE calculation:

- 1.Using the estimated demand and the observed IVs (prices, ln(week), and within-year week index dummies), we predict Yoplait sales for each of the 573 weeks. We then plot it with the observed Yoplait sales (YOPLAIT UNITS) and the 95% PI upper and 95% PI lower interval.
- 2.It can be observed from the graph that the predicted sales explain the observed data pattern pretty well, except for extremely high or low observed values. We compute the Mean Absolute Percentage Error (MAPE) for each week, and then compute the average MAPE across 573 weeks. It was 7.26%, which is quite low.

Thus with confidence, we can use the estimated linear demand for the following analysis on price elasticities.

Change in Price Elasticities due to Chobani Entry

We use the weekly price elasticities and compute pre- and post-Chobani average own- and cross-price elasticities.
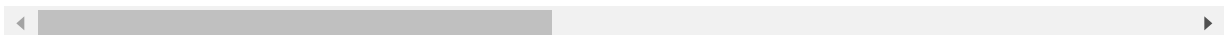
In [16]: `newdf`

Out[16]:

	WEEK	MONTH	YOPLAIT_UNITS	YOPLAIT_PRICE	DANNON_PRICE	CHOBANI_PRICE	LNW
0	1	Jan	1431790	0.76	1.04	0.00	0.00
1	2	Jan	1549503	0.80	0.94	0.00	0.69
2	3	Jan	1448646	0.83	1.02	0.00	1.09
3	4	Jan	1398011	0.82	1.10	0.00	1.38
4	5	Feb	1525899	0.81	1.10	0.00	1.60
5	6	Feb	1315745	0.87	0.89	0.00	1.79
6	7	Feb	1247943	0.87	1.00	0.00	1.94
7	8	Feb	1206063	0.89	1.06	0.00	2.07
8	9	Mar	1541804	0.85	1.11	0.00	2.19
9	10	Mar	1493644	0.83	1.11	0.00	2.30
10	11	Mar	1355595	0.87	0.93	0.00	2.39
11	12	Mar	1309235	0.91	1.09	0.00	2.48
12	13	Mar	1370437	0.87	1.11	0.00	2.56
13	14	Apr	1498930	0.84	1.02	0.00	2.63
14	15	Apr	1321056	0.89	1.10	0.00	2.70
15	16	Apr	1203680	0.87	0.97	0.00	2.77
16	17	Apr	1236598	0.94	0.94	0.00	2.83
17	18	May	1493550	0.88	1.11	0.00	2.89
18	19	May	1262692	0.95	1.02	0.00	2.94
19	20	May	1365748	0.87	0.93	0.00	2.99
20	21	May	1283943	0.92	1.08	0.00	3.04
21	22	May	1373136	0.86	1.03	0.00	3.09
22	23	Jun	1550108	0.84	0.94	0.00	3.13
23	24	Jun	1411876	0.84	1.06	0.00	3.17
24	25	Jun	1277361	0.87	0.99	0.00	3.21
25	26	Jun	1158561	0.91	1.05	0.00	3.25
26	27	Jul	1259457	0.88	1.09	0.00	3.29
27	28	Jul	1175128	0.92	0.96	0.00	3.33
28	29	Jul	1310654	0.87	1.04	0.00	3.36
29	30	Jul	1264448	0.88	1.10	0.00	3.40
...	...	...	...	...	...	...	
543	544	Jun	1903941	0.85	1.56	1.40	6.29
544	545	Jun	1654621	0.97	1.54	1.39	6.30
545	546	Jun	1737019	0.93	1.42	1.40	6.30

	WEEK	MONTH	YOPLAIT_UNITS	YOPLAIT_PRICE	DANNON_PRICE	CHOBANI_PRICE	LNW
546	547	Jun	1759658	0.91	1.66	1.40	6.30
547	548	Jun	1746264	0.91	1.63	1.41	6.30
548	549	Jul	1615631	0.99	1.54	1.41	6.30
549	550	Jul	1851221	0.93	1.60	1.40	6.30
550	551	Jul	1898320	0.89	1.61	1.41	6.31
551	552	Jul	1509453	0.99	1.50	1.39	6.31
552	553	Aug	1879026	0.95	1.65	1.28	6.31
553	554	Aug	2025709	0.97	1.58	1.37	6.31
554	555	Aug	1867477	0.95	1.65	1.38	6.31
555	556	Aug	1594002	1.03	1.65	1.23	6.32
556	557	Sep	1613750	1.02	1.63	1.37	6.32
557	558	Sep	2032965	0.95	1.61	1.33	6.32
558	559	Sep	1745274	1.06	1.64	1.41	6.32
559	560	Sep	1679836	1.03	1.67	1.36	6.32
560	561	Sep	1792941	0.99	1.71	1.36	6.32
561	562	Oct	1890071	0.97	1.64	1.29	6.33
562	563	Oct	1854960	0.99	1.73	1.24	6.33
563	564	Oct	1681291	1.00	1.68	1.32	6.33
564	565	Oct	1570368	0.99	1.78	1.31	6.33
565	566	Nov	1570216	1.00	1.76	1.21	6.33
566	567	Nov	1737014	0.97	1.86	1.30	6.34
567	568	Nov	1428985	1.06	1.75	1.31	6.34
568	569	Nov	1076198	1.10	1.77	1.38	6.34
569	570	Dec	1523707	1.00	1.83	1.31	6.34
570	571	Dec	1579472	1.00	1.88	1.28	6.34
571	572	Dec	1223610	1.07	1.85	1.25	6.34
572	573	Dec	1092610	1.04	1.90	1.40	6.35

573 rows × 23 columns

In [17]:
```python
newdf["Own_elasticity"]= Para_Est.iloc[1,1] * newdf["YOPLAIT_PRICE"]/ newdf["P
REDICTED YOPLAIT UNITS"]
newdf["Cross_elasticity($Dannon)"]= Para_Est.iloc[2,1]* newdf["DANNON_PRICE"]/
newdf["PREDICTED YOPLAIT UNITS"]
newdf["Cross_elasticity($Chobani)"]= Para_Est.iloc[3,1]* newdf["CHOBANI_PRICE"
]/newdf["PREDICTED YOPLAIT UNITS"]
newdf
```
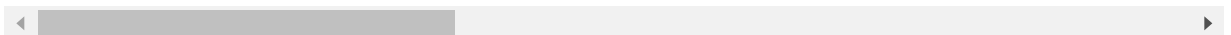
Out[17]:

	WEEK	MONTH	YOPLAIT_UNITS	YOPLAIT_PRICE	DANNON_PRICE	CHOBANI_PRICE	LNW
0	1	Jan	1431790	0.76	1.04	0.00	0.00
1	2	Jan	1549503	0.80	0.94	0.00	0.69
2	3	Jan	1448646	0.83	1.02	0.00	1.09
3	4	Jan	1398011	0.82	1.10	0.00	1.38
4	5	Feb	1525899	0.81	1.10	0.00	1.60
5	6	Feb	1315745	0.87	0.89	0.00	1.79
6	7	Feb	1247943	0.87	1.00	0.00	1.94
7	8	Feb	1206063	0.89	1.06	0.00	2.07
8	9	Mar	1541804	0.85	1.11	0.00	2.19
9	10	Mar	1493644	0.83	1.11	0.00	2.30
10	11	Mar	1355595	0.87	0.93	0.00	2.39
11	12	Mar	1309235	0.91	1.09	0.00	2.48
12	13	Mar	1370437	0.87	1.11	0.00	2.56
13	14	Apr	1498930	0.84	1.02	0.00	2.63
14	15	Apr	1321056	0.89	1.10	0.00	2.70
15	16	Apr	1203680	0.87	0.97	0.00	2.77
16	17	Apr	1236598	0.94	0.94	0.00	2.83
17	18	May	1493550	0.88	1.11	0.00	2.89
18	19	May	1262692	0.95	1.02	0.00	2.94
19	20	May	1365748	0.87	0.93	0.00	2.99
20	21	May	1283943	0.92	1.08	0.00	3.04
21	22	May	1373136	0.86	1.03	0.00	3.09
22	23	Jun	1550108	0.84	0.94	0.00	3.13
23	24	Jun	1411876	0.84	1.06	0.00	3.17
24	25	Jun	1277361	0.87	0.99	0.00	3.21
25	26	Jun	1158561	0.91	1.05	0.00	3.25
26	27	Jul	1259457	0.88	1.09	0.00	3.29
27	28	Jul	1175128	0.92	0.96	0.00	3.33
28	29	Jul	1310654	0.87	1.04	0.00	3.36
29	30	Jul	1264448	0.88	1.10	0.00	3.40
...	...	...	...	...	...	...	
543	544	Jun	1903941	0.85	1.56	1.40	6.29
544	545	Jun	1654621	0.97	1.54	1.39	6.30
545	546	Jun	1737019	0.93	1.42	1.40	6.30

	WEEK	MONTH	YOPLAIT_UNITS	YOPLAIT_PRICE	DANNON_PRICE	CHOBANI_PRICE	LNW
546	547	Jun	1759658	0.91	1.66	1.40	6.30
547	548	Jun	1746264	0.91	1.63	1.41	6.30
548	549	Jul	1615631	0.99	1.54	1.41	6.30
549	550	Jul	1851221	0.93	1.60	1.40	6.30
550	551	Jul	1898320	0.89	1.61	1.41	6.31
551	552	Jul	1509453	0.99	1.50	1.39	6.31
552	553	Aug	1879026	0.95	1.65	1.28	6.31
553	554	Aug	2025709	0.97	1.58	1.37	6.31
554	555	Aug	1867477	0.95	1.65	1.38	6.31
555	556	Aug	1594002	1.03	1.65	1.23	6.32
556	557	Sep	1613750	1.02	1.63	1.37	6.32
557	558	Sep	2032965	0.95	1.61	1.33	6.32
558	559	Sep	1745274	1.06	1.64	1.41	6.32
559	560	Sep	1679836	1.03	1.67	1.36	6.32
560	561	Sep	1792941	0.99	1.71	1.36	6.32
561	562	Oct	1890071	0.97	1.64	1.29	6.33
562	563	Oct	1854960	0.99	1.73	1.24	6.33
563	564	Oct	1681291	1.00	1.68	1.32	6.33
564	565	Oct	1570368	0.99	1.78	1.31	6.33
565	566	Nov	1570216	1.00	1.76	1.21	6.33
566	567	Nov	1737014	0.97	1.86	1.30	6.34
567	568	Nov	1428985	1.06	1.75	1.31	6.34
568	569	Nov	1076198	1.10	1.77	1.38	6.34
569	570	Dec	1523707	1.00	1.83	1.31	6.34
570	571	Dec	1579472	1.00	1.88	1.28	6.34
571	572	Dec	1223610	1.07	1.85	1.25	6.34
572	573	Dec	1092610	1.04	1.90	1.40	6.35

573 rows × 26 columns

In [18]:
```
C1=newdf.iloc[0:355,:]
C1
```

Out[18]:

	WEEK	MONTH	YOPLAIT_UNITS	YOPLAIT_PRICE	DANNON_PRICE	CHOBANI_PRICE	LNW
0	1	Jan	1431790	0.76	1.04	0.0	0.00
1	2	Jan	1549503	0.80	0.94	0.0	0.69
2	3	Jan	1448646	0.83	1.02	0.0	1.09
3	4	Jan	1398011	0.82	1.10	0.0	1.38
4	5	Feb	1525899	0.81	1.10	0.0	1.60
5	6	Feb	1315745	0.87	0.89	0.0	1.79
6	7	Feb	1247943	0.87	1.00	0.0	1.94
7	8	Feb	1206063	0.89	1.06	0.0	2.07
8	9	Mar	1541804	0.85	1.11	0.0	2.19
9	10	Mar	1493644	0.83	1.11	0.0	2.30
10	11	Mar	1355595	0.87	0.93	0.0	2.39
11	12	Mar	1309235	0.91	1.09	0.0	2.48
12	13	Mar	1370437	0.87	1.11	0.0	2.56
13	14	Apr	1498930	0.84	1.02	0.0	2.63
14	15	Apr	1321056	0.89	1.10	0.0	2.70
15	16	Apr	1203680	0.87	0.97	0.0	2.77
16	17	Apr	1236598	0.94	0.94	0.0	2.83
17	18	May	1493550	0.88	1.11	0.0	2.89
18	19	May	1262692	0.95	1.02	0.0	2.94
19	20	May	1365748	0.87	0.93	0.0	2.99
20	21	May	1283943	0.92	1.08	0.0	3.04
21	22	May	1373136	0.86	1.03	0.0	3.09
22	23	Jun	1550108	0.84	0.94	0.0	3.13
23	24	Jun	1411876	0.84	1.06	0.0	3.17
24	25	Jun	1277361	0.87	0.99	0.0	3.21
25	26	Jun	1158561	0.91	1.05	0.0	3.25
26	27	Jul	1259457	0.88	1.09	0.0	3.29
27	28	Jul	1175128	0.92	0.96	0.0	3.33
28	29	Jul	1310654	0.87	1.04	0.0	3.36
29	30	Jul	1264448	0.88	1.10	0.0	3.40
...	...	...	...	...	...	...	
325	326	Mar	2010947	0.82	1.15	0.0	5.78
326	327	Apr	2072191	0.83	1.33	0.0	5.78
327	328	Apr	1860287	0.84	1.20	0.0	5.79

	WEEK	MONTH	YOPLAIT_UNITS	YOPLAIT_PRICE	DANNON_PRICE	CHOBANI_PRICE	LNW
328	329	Apr	2308603	0.75	1.17	0.0	5.79
329	330	Apr	2085048	0.81	1.14	0.0	5.79
330	331	May	2328731	0.77	1.17	0.0	5.80
331	332	May	2594268	0.73	1.24	0.0	5.80
332	333	May	2053628	0.80	1.18	0.0	5.80
333	334	May	2028639	0.79	1.28	0.0	5.81
334	335	May	2180713	0.77	1.19	0.0	5.81
335	336	Jun	2346057	0.74	1.15	0.0	5.81
336	337	Jun	2223429	0.76	1.23	0.0	5.82
337	338	Jun	2076794	0.76	1.22	0.0	5.82
338	339	Jun	1869966	0.82	1.28	0.0	5.82
339	340	Jul	1790525	0.83	1.26	0.0	5.82
340	341	Jul	2035924	0.81	1.41	0.0	5.83
341	342	Jul	1884044	0.81	1.20	0.0	5.83
342	343	Jul	2308044	0.72	1.45	0.0	5.83
343	344	Aug	2038505	0.81	1.38	0.0	5.84
344	345	Aug	1979502	0.84	1.19	0.0	5.84
345	346	Aug	2241296	0.79	1.31	0.0	5.84
346	347	Aug	2392656	0.77	1.47	0.0	5.84
347	348	Aug	1971806	0.87	1.46	0.0	5.85
348	349	Sep	2201017	0.86	1.23	0.0	5.85
349	350	Sep	2187952	0.86	1.34	0.0	5.85
350	351	Sep	2323594	0.81	1.42	0.0	5.86
351	352	Sep	2482849	0.77	1.40	0.0	5.86
352	353	Oct	2543017	0.79	1.34	0.0	5.86
353	354	Oct	2479046	0.79	1.42	0.0	5.86
354	355	Oct	2286465	0.81	1.31	0.0	5.87

355 rows × 26 columns
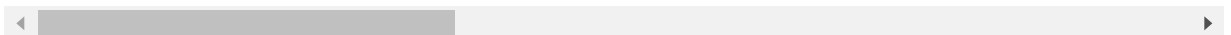
```
In [19]: C1["Own_elasticity"].mean()
```

Out[19]: -2.2836216791501704

```
In [20]: C1["Cross_elasticity($Dannon)"].mean()
```

Out[20]: 0.05614998038497148

```
In [21]: C2= newdf.iloc[355:,:]
         C2
```

Out[21]:

	WEEK	MONTH	YOPLAIT_UNITS	YOPLAIT_PRICE	DANNON_PRICE	CHOBANI_PRICE	LNW
355	356	Oct	2043922	0.84	1.39	1.59	5.87
356	357	Nov	2124336	0.83	1.34	1.81	5.87
357	358	Nov	1920303	0.87	1.38	1.87	5.88
358	359	Nov	1792904	0.90	1.37	1.77	5.88
359	360	Nov	1504751	0.90	1.49	1.91	5.88
360	361	Nov	2170956	0.81	1.36	1.77	5.88
361	362	Dec	1882789	0.88	1.40	1.60	5.89
362	363	Dec	2031723	0.83	1.43	1.66	5.89
363	364	Dec	1497527	0.88	1.50	1.73	5.89
364	365	Dec	1329942	0.87	1.51	1.71	5.89
365	366	Jan	2885652	0.68	1.25	1.71	5.90
366	367	Jan	3297557	0.67	1.04	1.78	5.90
367	368	Jan	2682321	0.80	1.19	1.79	5.90
368	369	Jan	2214002	0.85	1.33	1.78	5.91
369	370	Jan	2463497	0.82	1.37	1.78	5.91
370	371	Feb	2530724	0.84	1.25	1.37	5.91
371	372	Feb	2584175	0.81	1.40	1.70	5.91
372	373	Feb	2437308	0.84	1.32	1.70	5.92
373	374	Feb	2603196	0.83	1.45	1.64	5.92
374	375	Mar	2402458	0.89	1.24	1.67	5.92
375	376	Mar	2927317	0.74	1.42	1.19	5.92
376	377	Mar	2465764	0.83	1.49	1.59	5.93
377	378	Mar	2094173	0.88	1.54	1.22	5.93
378	379	Apr	2309544	0.90	1.38	1.76	5.93
379	380	Apr	2230684	0.91	1.18	1.69	5.94
380	381	Apr	2473041	0.86	1.57	1.69	5.94
381	382	Apr	2841959	0.80	1.46	1.74	5.94
382	383	May	2788426	0.80	1.49	1.49	5.94
383	384	May	2571108	0.84	1.40	1.64	5.95
384	385	May	2548138	0.82	1.44	1.71	5.95
...	...	...	...	...	...	...	
543	544	Jun	1903941	0.85	1.56	1.40	6.29
544	545	Jun	1654621	0.97	1.54	1.39	6.30
545	546	Jun	1737019	0.93	1.42	1.40	6.30

	WEEK	MONTH	YOPLAIT_UNITS	YOPLAIT_PRICE	DANNON_PRICE	CHOBANI_PRICE	LNW
546	547	Jun	1759658	0.91	1.66	1.40	6.30
547	548	Jun	1746264	0.91	1.63	1.41	6.30
548	549	Jul	1615631	0.99	1.54	1.41	6.30
549	550	Jul	1851221	0.93	1.60	1.40	6.30
550	551	Jul	1898320	0.89	1.61	1.41	6.31
551	552	Jul	1509453	0.99	1.50	1.39	6.31
552	553	Aug	1879026	0.95	1.65	1.28	6.31
553	554	Aug	2025709	0.97	1.58	1.37	6.31
554	555	Aug	1867477	0.95	1.65	1.38	6.31
555	556	Aug	1594002	1.03	1.65	1.23	6.32
556	557	Sep	1613750	1.02	1.63	1.37	6.32
557	558	Sep	2032965	0.95	1.61	1.33	6.32
558	559	Sep	1745274	1.06	1.64	1.41	6.32
559	560	Sep	1679836	1.03	1.67	1.36	6.32
560	561	Sep	1792941	0.99	1.71	1.36	6.32
561	562	Oct	1890071	0.97	1.64	1.29	6.33
562	563	Oct	1854960	0.99	1.73	1.24	6.33
563	564	Oct	1681291	1.00	1.68	1.32	6.33
564	565	Oct	1570368	0.99	1.78	1.31	6.33
565	566	Nov	1570216	1.00	1.76	1.21	6.33
566	567	Nov	1737014	0.97	1.86	1.30	6.34
567	568	Nov	1428985	1.06	1.75	1.31	6.34
568	569	Nov	1076198	1.10	1.77	1.38	6.34
569	570	Dec	1523707	1.00	1.83	1.31	6.34
570	571	Dec	1579472	1.00	1.88	1.28	6.34
571	572	Dec	1223610	1.07	1.85	1.25	6.34
572	573	Dec	1092610	1.04	1.90	1.40	6.35

218 rows × 26 columns
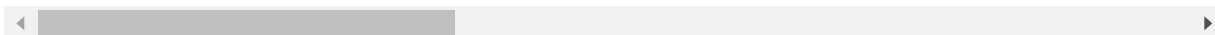
```
In [22]: C2["Own_elasticity"].mean()
```

Out[22]: -1.7857630542663008

```
In [23]: C2["Cross_elasticity($Dannon)"].mean()
```

Out[23]: 0.0545319714418715 2

In [24]:
```python
C2["Cross_elasticity($Chobani)"].mean()
```

Out[24]: `0.16950989547367418`

In [25]:
```python
D1=pd.DataFrame({'Before Chobani entry: %Δ in unit sales of YOPLAIT':[-2.284,
0.056,"N/A"],
                'After Chobani entry: %Δ in unit sales of YOPLAIT':[-1.786,
0.055,0.170],
                'Price change':["1%_change_$YOPLAIT", "1%_change_$DANNON",
"1%_change_$CHOBANI"]},
                index=[1,2,3])
D1=D1.set_index('Price change')
D1
```

Out[25]:

Price change	Before Chobani entry: %Δ in unit sales of YOPLAIT	After Chobani entry: %Δ in unit sales of YOPLAIT
1%_change_$YOPLAIT	-2.284	-1.786
1%_change_$DANNON	0.056	0.055
1%_change_$CHOBANI	N/A	0.170

- Then to illustrate the effect of Chobani's entry, the price elasticities are calculated to see whether the Chobani's entry will affect the elasticities. Three price-related elasticities can be calculated using the formulas:

  ```
  Own_elasticity = b1 * Yoplait Price/ predict sales
  Cross_elasticity(Dannon) = b2 * Dannon Price/ predict sales
  Cross_elasticity(Dannon) = b3 * Chobani Price/ predict sales
     *The predict sales are obtained by taking independent variables into the e
  stimated linear regression function.
  ```

- To compare the elasticities change after Chobani's entry, we firstly take the average of the weekly price elasticity between week 1 and week 355 for "Before Chobani entry", and take the average of the weekly price elasticity between week 356 and 753 for "After Chobani entry".

Comparing the change in elasticities, it can be observed that:

- 1.There is a decrease in Yoplait own-price elasticity after Chobani's entry, which means customers became less sensitive to Yoplait price.
- 2.On the other hand, the cross-price elasticity with respect to Dannon's price remained the same after Chobani's entry. It suggests that Chobani's entry did not significantly affect the substitutability of Yoplait for Dannon.
- 3.The comparison between the two cross-price elasticities values (Dannon v/s Chobani) indicates that Yoplait serves as a better substitute for Chobani than for Dannon (0.170 v/s 0.055).
- 4.The decrease of own-price elasticity of Yoplait price can be explained based on our previous interpretation: among the original Yoplait consumers, some consumers switched to Chobani after its entry. This is likely because Yoplait and Chobani are better substitutes. Now, the remaining consumers are relatively more loyal Yoplait consumers (that's why they didn't switch). This could be the reasoning behind why the Yoplait demand is less elastic than it was before Chobani's entry.
- 5.Since remaining Yoplait consumers post-Chobani are more loyal than those pre-Chobani, it is likely that we can charge a higher price for Yoplait post-Chobani than that pre-Chobani. This might lead to margin improvement even though Yoplait lost some consumers to Chobani.