Li_Final_Project

May 16, 2019

1 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]: 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	\
0	1	Jan	1431790	0.76	1.04	0.00	
1	2	Jan	1549503	0.80	0.94	0.00	
2	3	Jan	1448646	0.83	1.02	0.00	
3	4	Jan	1398011	0.82	1.10	0.00	
4	5	Feb	1525899	0.81	1.10	0.00	
5	6	Feb	1315745	0.87	0.89	0.00	
6	7	Feb	1247943	0.87	1.00	0.00	
7	8	Feb	1206063	0.89	1.06	0.00	
8	9	Mar	1541804	0.85	1.11	0.00	
9	10	Mar	1493644	0.83	1.11	0.00	
10	11	Mar	1355595	0.87	0.93	0.00	
11	12	Mar	1309235	0.91	1.09	0.00	
12	13	Mar	1370437	0.87	1.11	0.00	
13	14	Apr	1498930	0.84	1.02	0.00	
14	15	Apr	1321056	0.89	1.10	0.00	
15	16	Apr	1203680	0.87	0.97	0.00	

16	17	Apr	1236598	0.94	0.94	0.00
17	18	May	1493550	0.88	1.11	0.00
18	19	May	1262692	0.95	1.02	0.00
19	20	May	1365748	0.87	0.93	0.00
20	21	May	1283943	0.92	1.08	0.00
21	22	May	1373136	0.86	1.03	0.00
22	23	Jun	1550108	0.84	0.94	0.00
23	24	Jun	1411876	0.84	1.06	0.00
24	25	Jun	1277361	0.87	0.99	0.00
25	26	Jun	1158561	0.91	1.05	0.00
26	27	Jul	1259457	0.88	1.09	0.00
27	28	Jul	1175128	0.92	0.96	0.00
28	29	Jul	1310654	0.87	1.04	0.00
29	30	Jul	1264448	0.88	1.10	0.00
..	...	...	...	...	...	...
543	544	Jun	1903941	0.85	1.56	1.40
544	545	Jun	1654621	0.97	1.54	1.39
545	546	Jun	1737019	0.93	1.42	1.40
546	547	Jun	1759658	0.91	1.66	1.40
547	548	Jun	1746264	0.91	1.63	1.41
548	549	Jul	1615631	0.99	1.54	1.41
549	550	Jul	1851221	0.93	1.60	1.40
550	551	Jul	1898320	0.89	1.61	1.41
551	552	Jul	1509453	0.99	1.50	1.39
552	553	Aug	1879026	0.95	1.65	1.28
553	554	Aug	2025709	0.97	1.58	1.37
554	555	Aug	1867477	0.95	1.65	1.38
555	556	Aug	1594002	1.03	1.65	1.23
556	557	Sep	1613750	1.02	1.63	1.37
557	558	Sep	2032965	0.95	1.61	1.33
558	559	Sep	1745274	1.06	1.64	1.41
559	560	Sep	1679836	1.03	1.67	1.36
560	561	Sep	1792941	0.99	1.71	1.36
561	562	Oct	1890071	0.97	1.64	1.29
562	563	Oct	1854960	0.99	1.73	1.24
563	564	Oct	1681291	1.00	1.68	1.32
564	565	Oct	1570368	0.99	1.78	1.31
565	566	Nov	1570216	1.00	1.76	1.21
566	567	Nov	1737014	0.97	1.86	1.30
567	568	Nov	1428985	1.06	1.75	1.31
568	569	Nov	1076198	1.10	1.77	1.38
569	570	Dec	1523707	1.00	1.83	1.31
570	571	Dec	1579472	1.00	1.88	1.28
571	572	Dec	1223610	1.07	1.85	1.25
572	573	Dec	1092610	1.04	1.90	1.40

	LN(WEEK)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
0	0.000000	1	0	0	0	0	0	0	0	0	0	0

1	0.693147	1	0	0	0	0	0	0	0	0	0	0
2	1.098612	1	0	0	0	0	0	0	0	0	0	0
3	1.386294	1	0	0	0	0	0	0	0	0	0	0
4	1.609438	0	1	0	0	0	0	0	0	0	0	0
5	1.791759	0	1	0	0	0	0	0	0	0	0	0
6	1.945910	0	1	0	0	0	0	0	0	0	0	0
7	2.079442	0	1	0	0	0	0	0	0	0	0	0
8	2.197225	0	0	1	0	0	0	0	0	0	0	0
9	2.302585	0	0	1	0	0	0	0	0	0	0	0
10	2.397895	0	0	1	0	0	0	0	0	0	0	0
11	2.484907	0	0	1	0	0	0	0	0	0	0	0
12	2.564949	0	0	1	0	0	0	0	0	0	0	0
13	2.639057	0	0	0	1	0	0	0	0	0	0	0
14	2.708050	0	0	0	1	0	0	0	0	0	0	0
15	2.772589	0	0	0	1	0	0	0	0	0	0	0
16	2.833213	0	0	0	1	0	0	0	0	0	0	0
17	2.890372	0	0	0	0	1	0	0	0	0	0	0
18	2.944439	0	0	0	0	1	0	0	0	0	0	0
19	2.995732	0	0	0	0	1	0	0	0	0	0	0
20	3.044522	0	0	0	0	1	0	0	0	0	0	0
21	3.091042	0	0	0	0	1	0	0	0	0	0	0
22	3.135494	0	0	0	0	0	1	0	0	0	0	0
23	3.178054	0	0	0	0	0	1	0	0	0	0	0
24	3.218876	0	0	0	0	0	1	0	0	0	0	0
25	3.258097	0	0	0	0	0	1	0	0	0	0	0
26	3.295837	0	0	0	0	0	0	1	0	0	0	0
27	3.332205	0	0	0	0	0	0	1	0	0	0	0
28	3.367296	0	0	0	0	0	0	1	0	0	0	0
29	3.401197	0	0	0	0	0	0	1	0	0	0	0
..	...	...	...	...	...	...	...	...	...	...	...	...
543	6.298949	0	0	0	0	0	1	0	0	0	0	0
544	6.300786	0	0	0	0	0	1	0	0	0	0	0
545	6.302619	0	0	0	0	0	1	0	0	0	0	0
546	6.304449	0	0	0	0	0	1	0	0	0	0	0
547	6.306275	0	0	0	0	0	1	0	0	0	0	0
548	6.308098	0	0	0	0	0	0	1	0	0	0	0
549	6.309918	0	0	0	0	0	0	1	0	0	0	0
550	6.311735	0	0	0	0	0	0	1	0	0	0	0
551	6.313548	0	0	0	0	0	0	1	0	0	0	0
552	6.315358	0	0	0	0	0	0	0	1	0	0	0
553	6.317165	0	0	0	0	0	0	0	1	0	0	0
554	6.318968	0	0	0	0	0	0	0	1	0	0	0
555	6.320768	0	0	0	0	0	0	0	1	0	0	0
556	6.322565	0	0	0	0	0	0	0	0	1	0	0
557	6.324359	0	0	0	0	0	0	0	0	1	0	0
558	6.326149	0	0	0	0	0	0	0	0	1	0	0
559	6.327937	0	0	0	0	0	0	0	0	1	0	0
560	6.329721	0	0	0	0	0	0	0	0	1	0	0

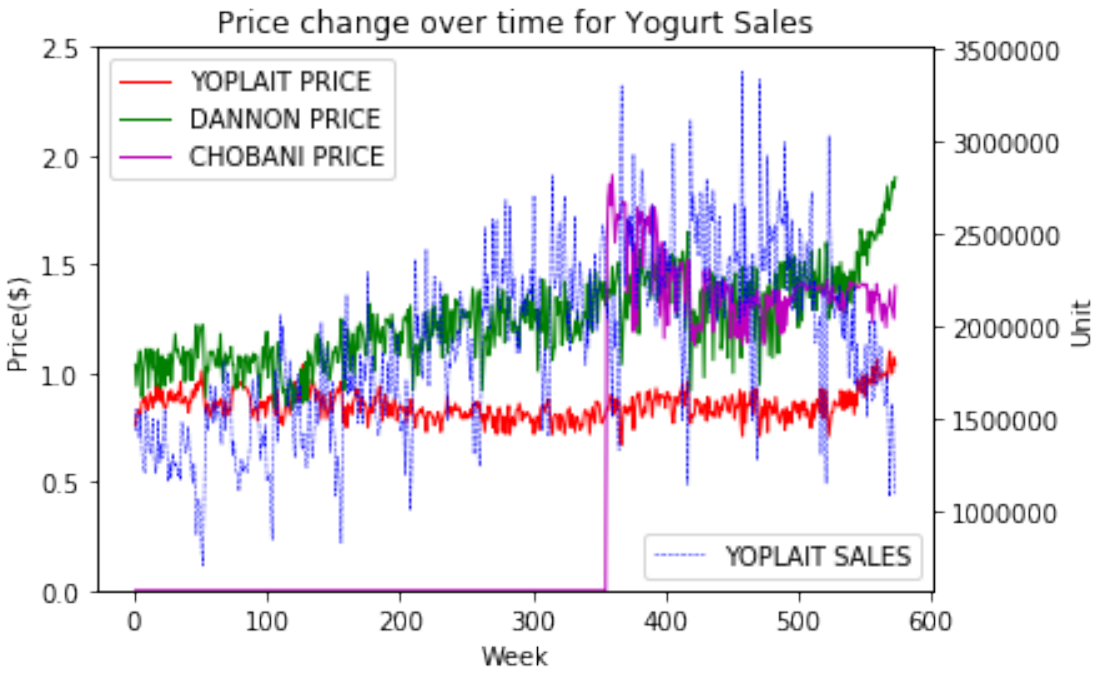
```
561  6.331502    0    0    0    0    0    0    0    0    0    1    0
562  6.333280    0    0    0    0    0    0    0    0    0    1    0
563  6.335054    0    0    0    0    0    0    0    0    0    1    0
564  6.336826    0    0    0    0    0    0    0    0    0    1    0
565  6.338594    0    0    0    0    0    0    0    0    0    0    1
566  6.340359    0    0    0    0    0    0    0    0    0    0    1
567  6.342121    0    0    0    0    0    0    0    0    0    0    1
568  6.343880    0    0    0    0    0    0    0    0    0    0    1
569  6.345636    0    0    0    0    0    0    0    0    0    0    0
570  6.347389    0    0    0    0    0    0    0    0    0    0    0
571  6.349139    0    0    0    0    0    0    0    0    0    0    0
572  6.350886    0    0    0    0    0    0    0    0    0    0    0

[573 rows x 18 columns]
```

1.0.1 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]:
```
#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.
- 2. Yoplait sales exhibit seasonality.
- 3. 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.
- 4. Yoplait's price is relatively stable until around week 500. Then its price starts to increase.
- 5. 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.

- 2. 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.
- 3. The sharp increase of Dannon's price is the reaction to the increase of Yoplait's price after week 500.

```
In [4]: df=df.rename(columns={df.columns[2]: "YOPLAIT_UNITS",df.columns[3]: "YOPLAIT_PRICE",
                                df.columns[4]: "DANNON_PRICE",df.columns[5]: "CHOBANI_PRICE",df.
        df
```

Out[4]:

	WEEK	MONTH	YOPLAIT_UNITS	YOPLAIT_PRICE	DANNON_PRICE	CHOBANI_PRICE	\
0	1	Jan	1431790	0.76	1.04	0.00	
1	2	Jan	1549503	0.80	0.94	0.00	
2	3	Jan	1448646	0.83	1.02	0.00	
3	4	Jan	1398011	0.82	1.10	0.00	
4	5	Feb	1525899	0.81	1.10	0.00	
5	6	Feb	1315745	0.87	0.89	0.00	
6	7	Feb	1247943	0.87	1.00	0.00	
7	8	Feb	1206063	0.89	1.06	0.00	
8	9	Mar	1541804	0.85	1.11	0.00	
9	10	Mar	1493644	0.83	1.11	0.00	
10	11	Mar	1355595	0.87	0.93	0.00	
11	12	Mar	1309235	0.91	1.09	0.00	
12	13	Mar	1370437	0.87	1.11	0.00	
13	14	Apr	1498930	0.84	1.02	0.00	
14	15	Apr	1321056	0.89	1.10	0.00	
15	16	Apr	1203680	0.87	0.97	0.00	
16	17	Apr	1236598	0.94	0.94	0.00	
17	18	May	1493550	0.88	1.11	0.00	
18	19	May	1262692	0.95	1.02	0.00	
19	20	May	1365748	0.87	0.93	0.00	
20	21	May	1283943	0.92	1.08	0.00	
21	22	May	1373136	0.86	1.03	0.00	
22	23	Jun	1550108	0.84	0.94	0.00	
23	24	Jun	1411876	0.84	1.06	0.00	
24	25	Jun	1277361	0.87	0.99	0.00	
25	26	Jun	1158561	0.91	1.05	0.00	
26	27	Jul	1259457	0.88	1.09	0.00	
27	28	Jul	1175128	0.92	0.96	0.00	
28	29	Jul	1310654	0.87	1.04	0.00	
29	30	Jul	1264448	0.88	1.10	0.00	
..	...	...	...	...	...	...	
543	544	Jun	1903941	0.85	1.56	1.40	
544	545	Jun	1654621	0.97	1.54	1.39	
545	546	Jun	1737019	0.93	1.42	1.40	
546	547	Jun	1759658	0.91	1.66	1.40	

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

	LNWEEK	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
0	0.000000	1	0	0	0	0	0	0	0	0	0	0
1	0.693147	1	0	0	0	0	0	0	0	0	0	0
2	1.098612	1	0	0	0	0	0	0	0	0	0	0
3	1.386294	1	0	0	0	0	0	0	0	0	0	0
4	1.609438	0	1	0	0	0	0	0	0	0	0	0
5	1.791759	0	1	0	0	0	0	0	0	0	0	0
6	1.945910	0	1	0	0	0	0	0	0	0	0	0
7	2.079442	0	1	0	0	0	0	0	0	0	0	0
8	2.197225	0	0	1	0	0	0	0	0	0	0	0
9	2.302585	0	0	1	0	0	0	0	0	0	0	0
10	2.397895	0	0	1	0	0	0	0	0	0	0	0
11	2.484907	0	0	1	0	0	0	0	0	0	0	0
12	2.564949	0	0	1	0	0	0	0	0	0	0	0
13	2.639057	0	0	0	1	0	0	0	0	0	0	0
14	2.708050	0	0	0	1	0	0	0	0	0	0	0
15	2.772589	0	0	0	1	0	0	0	0	0	0	0
16	2.833213	0	0	0	1	0	0	0	0	0	0	0
17	2.890372	0	0	0	0	1	0	0	0	0	0	0
18	2.944439	0	0	0	0	1	0	0	0	0	0	0
19	2.995732	0	0	0	0	1	0	0	0	0	0	0

20	3.044522	0	0	0	0	1	0	0	0	0	0	0
21	3.091042	0	0	0	0	1	0	0	0	0	0	0
22	3.135494	0	0	0	0	0	1	0	0	0	0	0
23	3.178054	0	0	0	0	0	1	0	0	0	0	0
24	3.218876	0	0	0	0	0	1	0	0	0	0	0
25	3.258097	0	0	0	0	0	1	0	0	0	0	0
26	3.295837	0	0	0	0	0	0	1	0	0	0	0
27	3.332205	0	0	0	0	0	0	1	0	0	0	0
28	3.367296	0	0	0	0	0	0	1	0	0	0	0
29	3.401197	0	0	0	0	0	0	1	0	0	0	0
..	...	...	...	...	...	...	...	...	...	...	...	...
543	6.298949	0	0	0	0	0	1	0	0	0	0	0
544	6.300786	0	0	0	0	0	1	0	0	0	0	0
545	6.302619	0	0	0	0	0	1	0	0	0	0	0
546	6.304449	0	0	0	0	0	1	0	0	0	0	0
547	6.306275	0	0	0	0	0	1	0	0	0	0	0
548	6.308098	0	0	0	0	0	0	1	0	0	0	0
549	6.309918	0	0	0	0	0	0	1	0	0	0	0
550	6.311735	0	0	0	0	0	0	1	0	0	0	0
551	6.313548	0	0	0	0	0	0	1	0	0	0	0
552	6.315358	0	0	0	0	0	0	0	1	0	0	0
553	6.317165	0	0	0	0	0	0	0	1	0	0	0
554	6.318968	0	0	0	0	0	0	0	1	0	0	0
555	6.320768	0	0	0	0	0	0	0	1	0	0	0
556	6.322565	0	0	0	0	0	0	0	0	1	0	0
557	6.324359	0	0	0	0	0	0	0	0	1	0	0
558	6.326149	0	0	0	0	0	0	0	0	1	0	0
559	6.327937	0	0	0	0	0	0	0	0	1	0	0
560	6.329721	0	0	0	0	0	0	0	0	1	0	0
561	6.331502	0	0	0	0	0	0	0	0	0	1	0
562	6.333280	0	0	0	0	0	0	0	0	0	1	0
563	6.335054	0	0	0	0	0	0	0	0	0	1	0
564	6.336826	0	0	0	0	0	0	0	0	0	1	0
565	6.338594	0	0	0	0	0	0	0	0	0	0	1
566	6.340359	0	0	0	0	0	0	0	0	0	0	1
567	6.342121	0	0	0	0	0	0	0	0	0	0	1
568	6.343880	0	0	0	0	0	0	0	0	0	0	1
569	6.345636	0	0	0	0	0	0	0	0	0	0	0
570	6.347389	0	0	0	0	0	0	0	0	0	0	0
571	6.349139	0	0	0	0	0	0	0	0	0	0	0
572	6.350886	0	0	0	0	0	0	0	0	0	0	0

[573 rows x 18 columns]

1.0.2 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+
        print(reg_all.summary())
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:          YOPLAIT_UNITS   R-squared:                       0.876
Model:                            OLS   Adj. R-squared:                  0.873
Method:                 Least Squares   F-statistic:                     262.0
Date:                Tue, 14 May 2019   Prob (F-statistic):          8.50e-241
Time:                        14:02:56   Log-Likelihood:                -7698.2
No. Observations:                 573   AIC:                         1.543e+04
Df Residuals:                     557   BIC:                         1.550e+04
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    4.41e+06
YOPLAIT_PRICE -4.307e+06   1.27e+05    -34.036      0.000   -4.56e+06   -4.06e+06
DANNON_PRICE   8.058e+04   5.42e+04      1.486      0.138    -2.6e+04    1.87e+05
CHOBANI_PRICE  2.559e+05    1.5e+04     17.008      0.000    2.26e+05    2.85e+05
LNWEEK         1.573e+05   1.04e+04     15.067      0.000    1.37e+05    1.78e+05
Jan            4.168e+05   3.75e+04     11.109      0.000    3.43e+05     4.9e+05
Feb            4.577e+05   3.67e+04     12.487      0.000    3.86e+05     5.3e+05
Mar            4.763e+05    3.5e+04     13.593      0.000    4.07e+05    5.45e+05
Apr            4.261e+05   3.53e+04     12.074      0.000    3.57e+05    4.95e+05
May            4.201e+05   3.51e+04     11.978      0.000    3.51e+05    4.89e+05
Jun             3.64e+05    3.5e+04     10.397      0.000    2.95e+05    4.33e+05
Jul            3.434e+05   3.43e+04     10.014      0.000    2.76e+05    4.11e+05
Aug            4.066e+05   3.44e+04     11.819      0.000    3.39e+05    4.74e+05
Sep            4.536e+05   3.45e+04     13.150      0.000    3.86e+05    5.21e+05
Oct            3.495e+05   3.51e+04      9.964      0.000    2.81e+05    4.18e+05
Nov             1.39e+05   3.45e+04      4.032      0.000    7.13e+04    2.07e+05
==============================================================================
Omnibus:                        6.978   Durbin-Watson:                   0.939
Prob(Omnibus):                  0.031   Jarque-Bera (JB):               10.093
Skew:                          -0.022   Prob(JB):                      0.00643
Kurtosis:                       3.649   Cond. No.                        155.
==============================================================================
```

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

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

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

        print('Estimated intercept coefficient:', intercept)

Estimated intercept coefficient: 4126408.170070924
```

```
In [8]: vari = X.columns.values.tolist()
        vari.insert(0, 'Intercept')
        Para_Est = pd.DataFrame(list(zip(vari, reg_all.params, reg_all.bse)), columns = ['Varia
        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 * Chobani Price + b4
  ```

- 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 Price + 255885.
+ 157304.1 * LnWeek + 416788.9 * Jan + 457736.1 * Feb + 476321.1 * Mar + 426062.7 * Apr +
+ 363990.5 * Jun + 343386.6 * Jul + 406551.8 * Aug + 453551.1 * Sep + 349466.7 * Oct + 13
```

- 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]: 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	\
0	1	Jan	1431790	0.76	1.04	0.00	
1	2	Jan	1549503	0.80	0.94	0.00	
2	3	Jan	1448646	0.83	1.02	0.00	
3	4	Jan	1398011	0.82	1.10	0.00	
4	5	Feb	1525899	0.81	1.10	0.00	
5	6	Feb	1315745	0.87	0.89	0.00	
6	7	Feb	1247943	0.87	1.00	0.00	
7	8	Feb	1206063	0.89	1.06	0.00	
8	9	Mar	1541804	0.85	1.11	0.00	
9	10	Mar	1493644	0.83	1.11	0.00	
10	11	Mar	1355595	0.87	0.93	0.00	
11	12	Mar	1309235	0.91	1.09	0.00	
12	13	Mar	1370437	0.87	1.11	0.00	
13	14	Apr	1498930	0.84	1.02	0.00	

14	15	Apr	1321056	0.89	1.10	0.00
15	16	Apr	1203680	0.87	0.97	0.00
16	17	Apr	1236598	0.94	0.94	0.00
17	18	May	1493550	0.88	1.11	0.00
18	19	May	1262692	0.95	1.02	0.00
19	20	May	1365748	0.87	0.93	0.00
20	21	May	1283943	0.92	1.08	0.00
21	22	May	1373136	0.86	1.03	0.00
22	23	Jun	1550108	0.84	0.94	0.00
23	24	Jun	1411876	0.84	1.06	0.00
24	25	Jun	1277361	0.87	0.99	0.00
25	26	Jun	1158561	0.91	1.05	0.00
26	27	Jul	1259457	0.88	1.09	0.00
27	28	Jul	1175128	0.92	0.96	0.00
28	29	Jul	1310654	0.87	1.04	0.00
29	30	Jul	1264448	0.88	1.10	0.00
..	...	...	...	...	...	...
543	544	Jun	1903941	0.85	1.56	1.40
544	545	Jun	1654621	0.97	1.54	1.39
545	546	Jun	1737019	0.93	1.42	1.40
546	547	Jun	1759658	0.91	1.66	1.40
547	548	Jun	1746264	0.91	1.63	1.41
548	549	Jul	1615631	0.99	1.54	1.41
549	550	Jul	1851221	0.93	1.60	1.40
550	551	Jul	1898320	0.89	1.61	1.41
551	552	Jul	1509453	0.99	1.50	1.39
552	553	Aug	1879026	0.95	1.65	1.28
553	554	Aug	2025709	0.97	1.58	1.37
554	555	Aug	1867477	0.95	1.65	1.38
555	556	Aug	1594002	1.03	1.65	1.23
556	557	Sep	1613750	1.02	1.63	1.37
557	558	Sep	2032965	0.95	1.61	1.33
558	559	Sep	1745274	1.06	1.64	1.41
559	560	Sep	1679836	1.03	1.67	1.36
560	561	Sep	1792941	0.99	1.71	1.36
561	562	Oct	1890071	0.97	1.64	1.29
562	563	Oct	1854960	0.99	1.73	1.24
563	564	Oct	1681291	1.00	1.68	1.32
564	565	Oct	1570368	0.99	1.78	1.31
565	566	Nov	1570216	1.00	1.76	1.21
566	567	Nov	1737014	0.97	1.86	1.30
567	568	Nov	1428985	1.06	1.75	1.31
568	569	Nov	1076198	1.10	1.77	1.38
569	570	Dec	1523707	1.00	1.83	1.31
570	571	Dec	1579472	1.00	1.88	1.28
571	572	Dec	1223610	1.07	1.85	1.25
572	573	Dec	1092610	1.04	1.90	1.40

	LNWEEK	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	\
0	0.000000	1	0	0	0	0	0	0	0	0	0	0	
1	0.693147	1	0	0	0	0	0	0	0	0	0	0	
2	1.098612	1	0	0	0	0	0	0	0	0	0	0	
3	1.386294	1	0	0	0	0	0	0	0	0	0	0	
4	1.609438	0	1	0	0	0	0	0	0	0	0	0	
5	1.791759	0	1	0	0	0	0	0	0	0	0	0	
6	1.945910	0	1	0	0	0	0	0	0	0	0	0	
7	2.079442	0	1	0	0	0	0	0	0	0	0	0	
8	2.197225	0	0	1	0	0	0	0	0	0	0	0	
9	2.302585	0	0	1	0	0	0	0	0	0	0	0	
10	2.397895	0	0	1	0	0	0	0	0	0	0	0	
11	2.484907	0	0	1	0	0	0	0	0	0	0	0	
12	2.564949	0	0	1	0	0	0	0	0	0	0	0	
13	2.639057	0	0	0	1	0	0	0	0	0	0	0	
14	2.708050	0	0	0	1	0	0	0	0	0	0	0	
15	2.772589	0	0	0	1	0	0	0	0	0	0	0	
16	2.833213	0	0	0	1	0	0	0	0	0	0	0	
17	2.890372	0	0	0	0	1	0	0	0	0	0	0	
18	2.944439	0	0	0	0	1	0	0	0	0	0	0	
19	2.995732	0	0	0	0	1	0	0	0	0	0	0	
20	3.044522	0	0	0	0	1	0	0	0	0	0	0	
21	3.091042	0	0	0	0	1	0	0	0	0	0	0	
22	3.135494	0	0	0	0	0	1	0	0	0	0	0	
23	3.178054	0	0	0	0	0	1	0	0	0	0	0	
24	3.218876	0	0	0	0	0	1	0	0	0	0	0	
25	3.258097	0	0	0	0	0	1	0	0	0	0	0	
26	3.295837	0	0	0	0	0	0	1	0	0	0	0	
27	3.332205	0	0	0	0	0	0	1	0	0	0	0	
28	3.367296	0	0	0	0	0	0	1	0	0	0	0	
29	3.401197	0	0	0	0	0	0	1	0	0	0	0	
..	...	...	...	...	...	...	...	...	...	...	...	...	...
543	6.298949	0	0	0	0	0	1	0	0	0	0	0	
544	6.300786	0	0	0	0	0	1	0	0	0	0	0	
545	6.302619	0	0	0	0	0	1	0	0	0	0	0	
546	6.304449	0	0	0	0	0	1	0	0	0	0	0	
547	6.306275	0	0	0	0	0	1	0	0	0	0	0	
548	6.308098	0	0	0	0	0	0	1	0	0	0	0	
549	6.309918	0	0	0	0	0	0	1	0	0	0	0	
550	6.311735	0	0	0	0	0	0	1	0	0	0	0	
551	6.313548	0	0	0	0	0	0	1	0	0	0	0	
552	6.315358	0	0	0	0	0	0	0	1	0	0	0	
553	6.317165	0	0	0	0	0	0	0	1	0	0	0	
554	6.318968	0	0	0	0	0	0	0	1	0	0	0	
555	6.320768	0	0	0	0	0	0	0	1	0	0	0	
556	6.322565	0	0	0	0	0	0	0	0	1	0	0	
557	6.324359	0	0	0	0	0	0	0	0	1	0	0	
558	6.326149	0	0	0	0	0	0	0	0	1	0	0	

559	6.327937	0	0	0	0	0	0	0	0	1	0	0
560	6.329721	0	0	0	0	0	0	0	0	1	0	0
561	6.331502	0	0	0	0	0	0	0	0	0	1	0
562	6.333280	0	0	0	0	0	0	0	0	0	1	0
563	6.335054	0	0	0	0	0	0	0	0	0	1	0
564	6.336826	0	0	0	0	0	0	0	0	0	1	0
565	6.338594	0	0	0	0	0	0	0	0	0	0	1
566	6.340359	0	0	0	0	0	0	0	0	0	0	1
567	6.342121	0	0	0	0	0	0	0	0	0	0	1
568	6.343880	0	0	0	0	0	0	0	0	0	0	1
569	6.345636	0	0	0	0	0	0	0	0	0	0	0
570	6.347389	0	0	0	0	0	0	0	0	0	0	0
571	6.349139	0	0	0	0	0	0	0	0	0	0	0
572	6.350886	0	0	0	0	0	0	0	0	0	0	0

	Monthly Dummy Effects
0	416788.905078
1	416788.905078
2	416788.905078
3	416788.905078
4	457736.148745
5	457736.148745
6	457736.148745
7	457736.148745
8	476321.069384
9	476321.069384
10	476321.069384
11	476321.069384
12	476321.069384
13	426062.711488
14	426062.711488
15	426062.711488
16	426062.711488
17	420077.724684
18	420077.724684
19	420077.724684
20	420077.724684
21	420077.724684
22	363990.520966
23	363990.520966
24	363990.520966
25	363990.520966
26	343386.604344
27	343386.604344
28	343386.604344
29	343386.604344
..	...
543	363990.520966

```
544          363990.520966
545          363990.520966
546          363990.520966
547          363990.520966
548          343386.604344
549          343386.604344
550          343386.604344
551          343386.604344
552          406551.827621
553          406551.827621
554          406551.827621
555          406551.827621
556          453551.117530
557          453551.117530
558          453551.117530
559          453551.117530
560          453551.117530
561          349466.722548
562          349466.722548
563          349466.722548
564          349466.722548
565          139042.340772
566          139042.340772
567          139042.340772
568          139042.340772
569               0.000000
570               0.000000
571               0.000000
572               0.000000

[573 rows x 19 columns]
```

In [11]:
```
newdf['PREDICTED YOPLAIT UNITS'] = newdf['Monthly Dummy Effects'] + intercept + Para_
    'YOPLAIT_PRICE'] + Para_Est.iloc[2,1] * newdf['DANNON_PRICE'] + Para_Est.iloc[3,1
    '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	\
0	1	Jan	1431790	0.76	1.04	0.00	
1	2	Jan	1549503	0.80	0.94	0.00	
2	3	Jan	1448646	0.83	1.02	0.00	
3	4	Jan	1398011	0.82	1.10	0.00	
4	5	Feb	1525899	0.81	1.10	0.00	
5	6	Feb	1315745	0.87	0.89	0.00	
6	7	Feb	1247943	0.87	1.00	0.00	
7	8	Feb	1206063	0.89	1.06	0.00	
8	9	Mar	1541804	0.85	1.11	0.00	

9	10	Mar	1493644	0.83	1.11	0.00
10	11	Mar	1355595	0.87	0.93	0.00
11	12	Mar	1309235	0.91	1.09	0.00
12	13	Mar	1370437	0.87	1.11	0.00
13	14	Apr	1498930	0.84	1.02	0.00
14	15	Apr	1321056	0.89	1.10	0.00
15	16	Apr	1203680	0.87	0.97	0.00
16	17	Apr	1236598	0.94	0.94	0.00
17	18	May	1493550	0.88	1.11	0.00
18	19	May	1262692	0.95	1.02	0.00
19	20	May	1365748	0.87	0.93	0.00
20	21	May	1283943	0.92	1.08	0.00
21	22	May	1373136	0.86	1.03	0.00
22	23	Jun	1550108	0.84	0.94	0.00
23	24	Jun	1411876	0.84	1.06	0.00
24	25	Jun	1277361	0.87	0.99	0.00
25	26	Jun	1158561	0.91	1.05	0.00
26	27	Jul	1259457	0.88	1.09	0.00
27	28	Jul	1175128	0.92	0.96	0.00
28	29	Jul	1310654	0.87	1.04	0.00
29	30	Jul	1264448	0.88	1.10	0.00
..	...	...	...	...	...	...
543	544	Jun	1903941	0.85	1.56	1.40
544	545	Jun	1654621	0.97	1.54	1.39
545	546	Jun	1737019	0.93	1.42	1.40
546	547	Jun	1759658	0.91	1.66	1.40
547	548	Jun	1746264	0.91	1.63	1.41
548	549	Jul	1615631	0.99	1.54	1.41
549	550	Jul	1851221	0.93	1.60	1.40
550	551	Jul	1898320	0.89	1.61	1.41
551	552	Jul	1509453	0.99	1.50	1.39
552	553	Aug	1879026	0.95	1.65	1.28
553	554	Aug	2025709	0.97	1.58	1.37
554	555	Aug	1867477	0.95	1.65	1.38
555	556	Aug	1594002	1.03	1.65	1.23
556	557	Sep	1613750	1.02	1.63	1.37
557	558	Sep	2032965	0.95	1.61	1.33
558	559	Sep	1745274	1.06	1.64	1.41
559	560	Sep	1679836	1.03	1.67	1.36
560	561	Sep	1792941	0.99	1.71	1.36
561	562	Oct	1890071	0.97	1.64	1.29
562	563	Oct	1854960	0.99	1.73	1.24
563	564	Oct	1681291	1.00	1.68	1.32
564	565	Oct	1570368	0.99	1.78	1.31
565	566	Nov	1570216	1.00	1.76	1.21
566	567	Nov	1737014	0.97	1.86	1.30
567	568	Nov	1428985	1.06	1.75	1.31
568	569	Nov	1076198	1.10	1.77	1.38

569	570	Dec	1523707	1.00	1.83	1.31
570	571	Dec	1579472	1.00	1.88	1.28
571	572	Dec	1223610	1.07	1.85	1.25
572	573	Dec	1092610	1.04	1.90	1.40

	LNWEEK	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	\
0	0.000000	1	0	0	0	0	0	0	0	0	0	0	
1	0.693147	1	0	0	0	0	0	0	0	0	0	0	
2	1.098612	1	0	0	0	0	0	0	0	0	0	0	
3	1.386294	1	0	0	0	0	0	0	0	0	0	0	
4	1.609438	0	1	0	0	0	0	0	0	0	0	0	
5	1.791759	0	1	0	0	0	0	0	0	0	0	0	
6	1.945910	0	1	0	0	0	0	0	0	0	0	0	
7	2.079442	0	1	0	0	0	0	0	0	0	0	0	
8	2.197225	0	0	1	0	0	0	0	0	0	0	0	
9	2.302585	0	0	1	0	0	0	0	0	0	0	0	
10	2.397895	0	0	1	0	0	0	0	0	0	0	0	
11	2.484907	0	0	1	0	0	0	0	0	0	0	0	
12	2.564949	0	0	1	0	0	0	0	0	0	0	0	
13	2.639057	0	0	0	1	0	0	0	0	0	0	0	
14	2.708050	0	0	0	1	0	0	0	0	0	0	0	
15	2.772589	0	0	0	1	0	0	0	0	0	0	0	
16	2.833213	0	0	0	1	0	0	0	0	0	0	0	
17	2.890372	0	0	0	0	1	0	0	0	0	0	0	
18	2.944439	0	0	0	0	1	0	0	0	0	0	0	
19	2.995732	0	0	0	0	1	0	0	0	0	0	0	
20	3.044522	0	0	0	0	1	0	0	0	0	0	0	
21	3.091042	0	0	0	0	1	0	0	0	0	0	0	
22	3.135494	0	0	0	0	0	1	0	0	0	0	0	
23	3.178054	0	0	0	0	0	1	0	0	0	0	0	
24	3.218876	0	0	0	0	0	1	0	0	0	0	0	
25	3.258097	0	0	0	0	0	1	0	0	0	0	0	
26	3.295837	0	0	0	0	0	0	1	0	0	0	0	
27	3.332205	0	0	0	0	0	0	1	0	0	0	0	
28	3.367296	0	0	0	0	0	0	1	0	0	0	0	
29	3.401197	0	0	0	0	0	0	1	0	0	0	0	
..	...	...	...	...	...	...	...	...	...	...	...	...	
543	6.298949	0	0	0	0	0	1	0	0	0	0	0	
544	6.300786	0	0	0	0	0	1	0	0	0	0	0	
545	6.302619	0	0	0	0	0	1	0	0	0	0	0	
546	6.304449	0	0	0	0	0	1	0	0	0	0	0	
547	6.306275	0	0	0	0	0	1	0	0	0	0	0	
548	6.308098	0	0	0	0	0	0	1	0	0	0	0	
549	6.309918	0	0	0	0	0	0	1	0	0	0	0	
550	6.311735	0	0	0	0	0	0	1	0	0	0	0	
551	6.313548	0	0	0	0	0	0	1	0	0	0	0	
552	6.315358	0	0	0	0	0	0	0	1	0	0	0	
553	6.317165	0	0	0	0	0	0	0	1	0	0	0	

554	6.318968	0	0	0	0	0	0	0	1	0	0	0
555	6.320768	0	0	0	0	0	0	0	1	0	0	0
556	6.322565	0	0	0	0	0	0	0	0	1	0	0
557	6.324359	0	0	0	0	0	0	0	0	1	0	0
558	6.326149	0	0	0	0	0	0	0	0	1	0	0
559	6.327937	0	0	0	0	0	0	0	0	1	0	0
560	6.329721	0	0	0	0	0	0	0	0	1	0	0
561	6.331502	0	0	0	0	0	0	0	0	0	1	0
562	6.333280	0	0	0	0	0	0	0	0	0	1	0
563	6.335054	0	0	0	0	0	0	0	0	0	1	0
564	6.336826	0	0	0	0	0	0	0	0	0	1	0
565	6.338594	0	0	0	0	0	0	0	0	0	0	1
566	6.340359	0	0	0	0	0	0	0	0	0	0	1
567	6.342121	0	0	0	0	0	0	0	0	0	0	1
568	6.343880	0	0	0	0	0	0	0	0	0	0	1
569	6.345636	0	0	0	0	0	0	0	0	0	0	0
570	6.347389	0	0	0	0	0	0	0	0	0	0	0
571	6.349139	0	0	0	0	0	0	0	0	0	0	0
572	6.350886	0	0	0	0	0	0	0	0	0	0	0

	Monthly Dummy Effects	PREDICTED YOPLAIT UNITS
0	416788.905078	1.353762e+06
1	416788.905078	1.282463e+06
2	416788.905078	1.223484e+06
3	416788.905078	1.318253e+06
4	457736.148745	1.437371e+06
5	457736.148745	1.190714e+06
6	457736.148745	1.223827e+06
7	457736.148745	1.163529e+06
8	476321.069384	1.376947e+06
9	476321.069384	1.479659e+06
10	476321.069384	1.307870e+06
11	476321.069384	1.162175e+06
12	476321.069384	1.348654e+06
13	426062.711488	1.432007e+06
14	426062.711488	1.233962e+06
15	426062.711488	1.319776e+06
16	426062.711488	1.025412e+06
17	420077.724684	1.300532e+06
18	420077.724684	1.000301e+06
19	420077.724684	1.345669e+06
20	420077.724684	1.150087e+06
21	420077.724684	1.411789e+06
22	363990.520966	1.441580e+06
23	363990.520966	1.457945e+06
24	363990.520966	1.329518e+06
25	363990.520966	1.168247e+06
26	343386.604344	1.286010e+06

```
27          343386.604344            1.108979e+06
28          343386.604344            1.336291e+06
29          343386.604344            1.303390e+06
..                    ...                     ...
543         363990.520966            2.304337e+06
544         363990.520966            1.783628e+06
545         363990.520966            1.949081e+06
546         363990.520966            2.054847e+06
547         363990.520966            2.055276e+06
548         343386.604344            1.683154e+06
549         343386.604344            1.944131e+06
550         343386.604344            2.120057e+06
551         343386.604344            1.675670e+06
552         406551.827621            1.895336e+06
553         406551.827621            1.826871e+06
554         406551.827621            1.921493e+06
555         406551.827621            1.538841e+06
556         453551.117530            1.663405e+06
557         453551.117530            1.953323e+06
558         453551.117530            1.502734e+06
559         453551.117530            1.621845e+06
560         453551.117530            1.797625e+06
561         349466.722548            1.756406e+06
562         349466.722548            1.665006e+06
563         349466.722548            1.638658e+06
564         349466.722548            1.687505e+06
565         139042.340772            1.407089e+06
566         139042.340772            1.567662e+06
567         139042.340772            1.174013e+06
568         139042.340772            1.021538e+06
569              0.000000            1.300384e+06
570              0.000000            1.297013e+06
571              0.000000            9.857110e+05
572              0.000000            1.157605e+06

[573 rows x 20 columns]
```

In [12]:
```
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
```

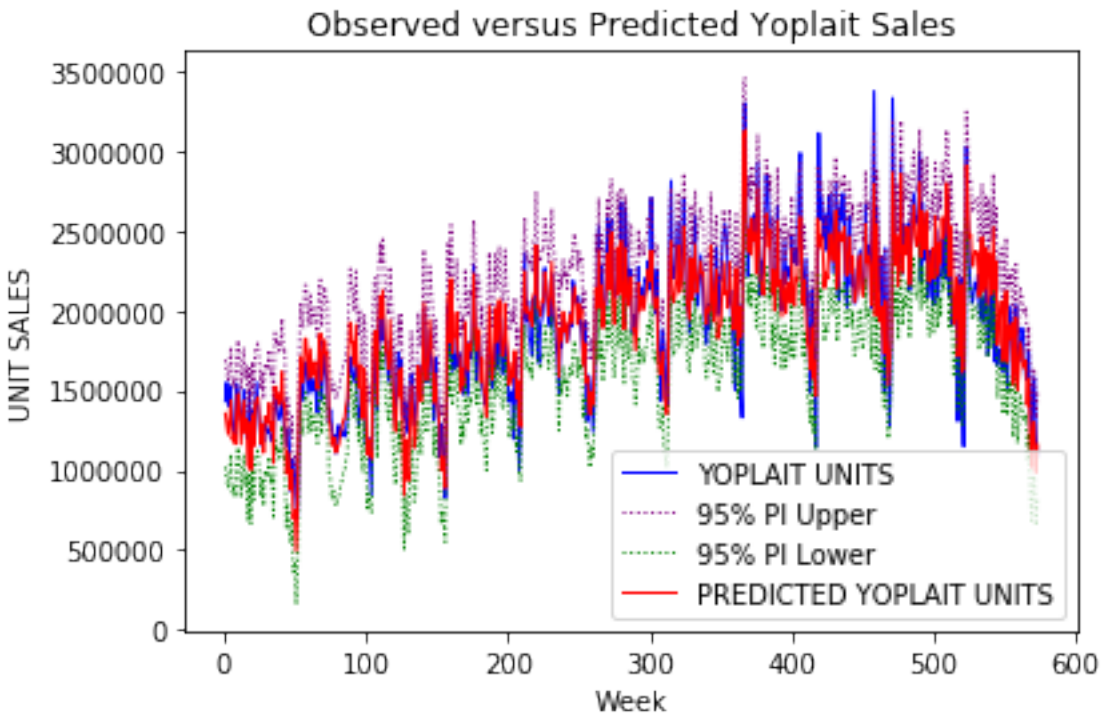
In [13]:
```
newdf['95PI_L'] = newdf['PREDICTED YOPLAIT UNITS'] - 2 * RSE
newdf['95PI_U'] = newdf['PREDICTED YOPLAIT UNITS'] + 2 * RSE
newdf['MAPE'] = abs(newdf['PREDICTED YOPLAIT UNITS'] - newdf['YOPLAIT_UNITS'])/newdf[
print("The the average Mean Absolute Percentage Error across 573 weeks was: {}".forma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

```
The the average Mean Absolute Percentage Error across 573 weeks was: 0.07259078870634533
```

```
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 UNITS"])
         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.

1.0.3 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	\
0	1	Jan	1431790	0.76	1.04	0.00	
1	2	Jan	1549503	0.80	0.94	0.00	
2	3	Jan	1448646	0.83	1.02	0.00	
3	4	Jan	1398011	0.82	1.10	0.00	
4	5	Feb	1525899	0.81	1.10	0.00	
5	6	Feb	1315745	0.87	0.89	0.00	
6	7	Feb	1247943	0.87	1.00	0.00	
7	8	Feb	1206063	0.89	1.06	0.00	
8	9	Mar	1541804	0.85	1.11	0.00	
9	10	Mar	1493644	0.83	1.11	0.00	
10	11	Mar	1355595	0.87	0.93	0.00	
11	12	Mar	1309235	0.91	1.09	0.00	
12	13	Mar	1370437	0.87	1.11	0.00	
13	14	Apr	1498930	0.84	1.02	0.00	
14	15	Apr	1321056	0.89	1.10	0.00	
15	16	Apr	1203680	0.87	0.97	0.00	
16	17	Apr	1236598	0.94	0.94	0.00	
17	18	May	1493550	0.88	1.11	0.00	
18	19	May	1262692	0.95	1.02	0.00	
19	20	May	1365748	0.87	0.93	0.00	
20	21	May	1283943	0.92	1.08	0.00	
21	22	May	1373136	0.86	1.03	0.00	
22	23	Jun	1550108	0.84	0.94	0.00	
23	24	Jun	1411876	0.84	1.06	0.00	
24	25	Jun	1277361	0.87	0.99	0.00	
25	26	Jun	1158561	0.91	1.05	0.00	
26	27	Jul	1259457	0.88	1.09	0.00	

27	28	Jul	1175128	0.92	0.96	0.00
28	29	Jul	1310654	0.87	1.04	0.00
29	30	Jul	1264448	0.88	1.10	0.00
..	...	...	...	...	...	...
543	544	Jun	1903941	0.85	1.56	1.40
544	545	Jun	1654621	0.97	1.54	1.39
545	546	Jun	1737019	0.93	1.42	1.40
546	547	Jun	1759658	0.91	1.66	1.40
547	548	Jun	1746264	0.91	1.63	1.41
548	549	Jul	1615631	0.99	1.54	1.41
549	550	Jul	1851221	0.93	1.60	1.40
550	551	Jul	1898320	0.89	1.61	1.41
551	552	Jul	1509453	0.99	1.50	1.39
552	553	Aug	1879026	0.95	1.65	1.28
553	554	Aug	2025709	0.97	1.58	1.37
554	555	Aug	1867477	0.95	1.65	1.38
555	556	Aug	1594002	1.03	1.65	1.23
556	557	Sep	1613750	1.02	1.63	1.37
557	558	Sep	2032965	0.95	1.61	1.33
558	559	Sep	1745274	1.06	1.64	1.41
559	560	Sep	1679836	1.03	1.67	1.36
560	561	Sep	1792941	0.99	1.71	1.36
561	562	Oct	1890071	0.97	1.64	1.29
562	563	Oct	1854960	0.99	1.73	1.24
563	564	Oct	1681291	1.00	1.68	1.32
564	565	Oct	1570368	0.99	1.78	1.31
565	566	Nov	1570216	1.00	1.76	1.21
566	567	Nov	1737014	0.97	1.86	1.30
567	568	Nov	1428985	1.06	1.75	1.31
568	569	Nov	1076198	1.10	1.77	1.38
569	570	Dec	1523707	1.00	1.83	1.31
570	571	Dec	1579472	1.00	1.88	1.28
571	572	Dec	1223610	1.07	1.85	1.25
572	573	Dec	1092610	1.04	1.90	1.40

	LNWEEK	Jan	Feb	Mar	...	Jul	Aug	Sep	Oct	Nov	\
0	0.000000	1	0	0	...	0	0	0	0	0	
1	0.693147	1	0	0	...	0	0	0	0	0	
2	1.098612	1	0	0	...	0	0	0	0	0	
3	1.386294	1	0	0	...	0	0	0	0	0	
4	1.609438	0	1	0	...	0	0	0	0	0	
5	1.791759	0	1	0	...	0	0	0	0	0	
6	1.945910	0	1	0	...	0	0	0	0	0	
7	2.079442	0	1	0	...	0	0	0	0	0	
8	2.197225	0	0	1	...	0	0	0	0	0	
9	2.302585	0	0	1	...	0	0	0	0	0	
10	2.397895	0	0	1	...	0	0	0	0	0	
11	2.484907	0	0	1	...	0	0	0	0	0	

12	2.564949	0	0	1	...	0	0	0	0	0
13	2.639057	0	0	0	...	0	0	0	0	0
14	2.708050	0	0	0	...	0	0	0	0	0
15	2.772589	0	0	0	...	0	0	0	0	0
16	2.833213	0	0	0	...	0	0	0	0	0
17	2.890372	0	0	0	...	0	0	0	0	0
18	2.944439	0	0	0	...	0	0	0	0	0
19	2.995732	0	0	0	...	0	0	0	0	0
20	3.044522	0	0	0	...	0	0	0	0	0
21	3.091042	0	0	0	...	0	0	0	0	0
22	3.135494	0	0	0	...	0	0	0	0	0
23	3.178054	0	0	0	...	0	0	0	0	0
24	3.218876	0	0	0	...	0	0	0	0	0
25	3.258097	0	0	0	...	0	0	0	0	0
26	3.295837	0	0	0	...	1	0	0	0	0
27	3.332205	0	0	0	...	1	0	0	0	0
28	3.367296	0	0	0	...	1	0	0	0	0
29	3.401197	0	0	0	...	1	0	0	0	0
..	...	...	...	...	...	...	...	...	...	...
543	6.298949	0	0	0	...	0	0	0	0	0
544	6.300786	0	0	0	...	0	0	0	0	0
545	6.302619	0	0	0	...	0	0	0	0	0
546	6.304449	0	0	0	...	0	0	0	0	0
547	6.306275	0	0	0	...	0	0	0	0	0
548	6.308098	0	0	0	...	1	0	0	0	0
549	6.309918	0	0	0	...	1	0	0	0	0
550	6.311735	0	0	0	...	1	0	0	0	0
551	6.313548	0	0	0	...	1	0	0	0	0
552	6.315358	0	0	0	...	0	1	0	0	0
553	6.317165	0	0	0	...	0	1	0	0	0
554	6.318968	0	0	0	...	0	1	0	0	0
555	6.320768	0	0	0	...	0	1	0	0	0
556	6.322565	0	0	0	...	0	0	1	0	0
557	6.324359	0	0	0	...	0	0	1	0	0
558	6.326149	0	0	0	...	0	0	1	0	0
559	6.327937	0	0	0	...	0	0	1	0	0
560	6.329721	0	0	0	...	0	0	1	0	0
561	6.331502	0	0	0	...	0	0	0	1	0
562	6.333280	0	0	0	...	0	0	0	1	0
563	6.335054	0	0	0	...	0	0	0	1	0
564	6.336826	0	0	0	...	0	0	0	1	0
565	6.338594	0	0	0	...	0	0	0	0	1
566	6.340359	0	0	0	...	0	0	0	0	1
567	6.342121	0	0	0	...	0	0	0	0	1
568	6.343880	0	0	0	...	0	0	0	0	1
569	6.345636	0	0	0	...	0	0	0	0	0
570	6.347389	0	0	0	...	0	0	0	0	0
571	6.349139	0	0	0	...	0	0	0	0	0

```
572  6.350886    0    0    0    ...       0    0    0    0    0

     Monthly Dummy Effects  PREDICTED YOPLAIT UNITS        95PI_L  \
0             416788.905078             1.353762e+06  1.018292e+06
1             416788.905078             1.282463e+06  9.469929e+05
2             416788.905078             1.223484e+06  8.880141e+05
3             416788.905078             1.318253e+06  9.827834e+05
4             457736.148745             1.437371e+06  1.101901e+06
5             457736.148745             1.190714e+06  8.552444e+05
6             457736.148745             1.223827e+06  8.883572e+05
7             457736.148745             1.163529e+06  8.280593e+05
8             476321.069384             1.376947e+06  1.041477e+06
9             476321.069384             1.479659e+06  1.144189e+06
10            476321.069384             1.307870e+06  9.724003e+05
11            476321.069384             1.162175e+06  8.267052e+05
12            476321.069384             1.348654e+06  1.013184e+06
13            426062.711488             1.432007e+06  1.096537e+06
14            426062.711488             1.233962e+06  8.984920e+05
15            426062.711488             1.319776e+06  9.843062e+05
16            426062.711488             1.025412e+06  6.899423e+05
17            420077.724684             1.300532e+06  9.650618e+05
18            420077.724684             1.000301e+06  6.648313e+05
19            420077.724684             1.345669e+06  1.010199e+06
20            420077.724684             1.150087e+06  8.146169e+05
21            420077.724684             1.411789e+06  1.076319e+06
22            363990.520966             1.441580e+06  1.106110e+06
23            363990.520966             1.457945e+06  1.122475e+06
24            363990.520966             1.329518e+06  9.940485e+05
25            363990.520966             1.168247e+06  8.327772e+05
26            343386.604344             1.286010e+06  9.505403e+05
27            343386.604344             1.108979e+06  7.735092e+05
28            343386.604344             1.336291e+06  1.000821e+06
29            343386.604344             1.303390e+06  9.679198e+05
..                      ...                      ...           ...
543           363990.520966             2.304337e+06  1.968868e+06
544           363990.520966             1.783628e+06  1.448158e+06
545           363990.520966             1.949081e+06  1.613611e+06
546           363990.520966             2.054847e+06  1.719377e+06
547           363990.520966             2.055276e+06  1.719806e+06
548           343386.604344             1.683154e+06  1.347684e+06
549           343386.604344             1.944131e+06  1.608661e+06
550           343386.604344             2.120057e+06  1.784587e+06
551           343386.604344             1.675670e+06  1.340200e+06
552           406551.827621             1.895336e+06  1.559867e+06
553           406551.827621             1.826871e+06  1.491402e+06
554           406551.827621             1.921493e+06  1.586023e+06
555           406551.827621             1.538841e+06  1.203372e+06
556           453551.117530             1.663405e+06  1.327935e+06
```

557	453551.117530	1.953323e+06	1.617853e+06
558	453551.117530	1.502734e+06	1.167264e+06
559	453551.117530	1.621845e+06	1.286375e+06
560	453551.117530	1.797625e+06	1.462155e+06
561	349466.722548	1.756406e+06	1.420936e+06
562	349466.722548	1.665006e+06	1.329536e+06
563	349466.722548	1.638658e+06	1.303188e+06
564	349466.722548	1.687505e+06	1.352035e+06
565	139042.340772	1.407089e+06	1.071620e+06
566	139042.340772	1.567662e+06	1.232192e+06
567	139042.340772	1.174013e+06	8.385433e+05
568	139042.340772	1.021538e+06	6.860678e+05
569	0.000000	1.300384e+06	9.649145e+05
570	0.000000	1.297013e+06	9.615429e+05
571	0.000000	9.857110e+05	6.502412e+05
572	0.000000	1.157605e+06	8.221350e+05

	95PI_U	MAPE
0	1.689232e+06	0.054497
1	1.617933e+06	0.172339
2	1.558954e+06	0.155429
3	1.653723e+06	0.057051
4	1.772841e+06	0.058017
5	1.526184e+06	0.095027
6	1.559297e+06	0.019325
7	1.498999e+06	0.035267
8	1.712417e+06	0.106925
9	1.815128e+06	0.009363
10	1.643340e+06	0.035206
11	1.497645e+06	0.112325
12	1.684123e+06	0.015895
13	1.767477e+06	0.044647
14	1.569432e+06	0.065928
15	1.655246e+06	0.096451
16	1.360882e+06	0.170780
17	1.636001e+06	0.129235
18	1.335771e+06	0.207803
19	1.681139e+06	0.014702
20	1.485557e+06	0.104254
21	1.747259e+06	0.028150
22	1.777050e+06	0.070013
23	1.793415e+06	0.032629
24	1.664988e+06	0.040832
25	1.503717e+06	0.008360
26	1.621480e+06	0.021083
27	1.444449e+06	0.056291
28	1.671761e+06	0.019560
29	1.638859e+06	0.030797

```
..            ...       ...
543  2.639807e+06  0.210299
544  2.119098e+06  0.077968
545  2.284551e+06  0.122084
546  2.390317e+06  0.167754
547  2.390746e+06  0.176956
548  2.018624e+06  0.041794
549  2.279600e+06  0.050188
550  2.455527e+06  0.116807
551  2.011140e+06  0.110118
552  2.230806e+06  0.008680
553  2.162341e+06  0.098157
554  2.256963e+06  0.028925
555  1.874311e+06  0.034605
556  1.998874e+06  0.030770
557  2.288792e+06  0.039176
558  1.838204e+06  0.138970
559  1.957315e+06  0.034522
560  2.133095e+06  0.002612
561  2.091876e+06  0.070720
562  2.000476e+06  0.102403
563  1.974127e+06  0.025357
564  2.022975e+06  0.074592
565  1.742559e+06  0.103888
566  1.903132e+06  0.097496
567  1.509483e+06  0.178429
568  1.357007e+06  0.050790
569  1.635854e+06  0.146565
570  1.632483e+06  0.178831
571  1.321181e+06  0.194424
572  1.493075e+06  0.059486

[573 rows x 23 columns]
```

In [17]:
```
newdf["Own_elasticity"]= Para_Est.iloc[1,1] * newdf["YOPLAIT_PRICE"]/ newdf["PREDICTE
newdf["Cross_elasticity($Dannon)"]= Para_Est.iloc[2,1]* newdf["DANNON_PRICE"]/newdf["
newdf["Cross_elasticity($Chobani)"]= Para_Est.iloc[3,1]* newdf["CHOBANI_PRICE"]/newdf
newdf
```

Out[17]:

	WEEK	MONTH	YOPLAIT_UNITS	YOPLAIT_PRICE	DANNON_PRICE	CHOBANI_PRICE	\
0	1	Jan	1431790	0.76	1.04	0.00	
1	2	Jan	1549503	0.80	0.94	0.00	
2	3	Jan	1448646	0.83	1.02	0.00	
3	4	Jan	1398011	0.82	1.10	0.00	
4	5	Feb	1525899	0.81	1.10	0.00	
5	6	Feb	1315745	0.87	0.89	0.00	
6	7	Feb	1247943	0.87	1.00	0.00	
7	8	Feb	1206063	0.89	1.06	0.00	

8	9	Mar	1541804	0.85	1.11	0.00
9	10	Mar	1493644	0.83	1.11	0.00
10	11	Mar	1355595	0.87	0.93	0.00
11	12	Mar	1309235	0.91	1.09	0.00
12	13	Mar	1370437	0.87	1.11	0.00
13	14	Apr	1498930	0.84	1.02	0.00
14	15	Apr	1321056	0.89	1.10	0.00
15	16	Apr	1203680	0.87	0.97	0.00
16	17	Apr	1236598	0.94	0.94	0.00
17	18	May	1493550	0.88	1.11	0.00
18	19	May	1262692	0.95	1.02	0.00
19	20	May	1365748	0.87	0.93	0.00
20	21	May	1283943	0.92	1.08	0.00
21	22	May	1373136	0.86	1.03	0.00
22	23	Jun	1550108	0.84	0.94	0.00
23	24	Jun	1411876	0.84	1.06	0.00
24	25	Jun	1277361	0.87	0.99	0.00
25	26	Jun	1158561	0.91	1.05	0.00
26	27	Jul	1259457	0.88	1.09	0.00
27	28	Jul	1175128	0.92	0.96	0.00
28	29	Jul	1310654	0.87	1.04	0.00
29	30	Jul	1264448	0.88	1.10	0.00
..	...	...	...	...	...	...
543	544	Jun	1903941	0.85	1.56	1.40
544	545	Jun	1654621	0.97	1.54	1.39
545	546	Jun	1737019	0.93	1.42	1.40
546	547	Jun	1759658	0.91	1.66	1.40
547	548	Jun	1746264	0.91	1.63	1.41
548	549	Jul	1615631	0.99	1.54	1.41
549	550	Jul	1851221	0.93	1.60	1.40
550	551	Jul	1898320	0.89	1.61	1.41
551	552	Jul	1509453	0.99	1.50	1.39
552	553	Aug	1879026	0.95	1.65	1.28
553	554	Aug	2025709	0.97	1.58	1.37
554	555	Aug	1867477	0.95	1.65	1.38
555	556	Aug	1594002	1.03	1.65	1.23
556	557	Sep	1613750	1.02	1.63	1.37
557	558	Sep	2032965	0.95	1.61	1.33
558	559	Sep	1745274	1.06	1.64	1.41
559	560	Sep	1679836	1.03	1.67	1.36
560	561	Sep	1792941	0.99	1.71	1.36
561	562	Oct	1890071	0.97	1.64	1.29
562	563	Oct	1854960	0.99	1.73	1.24
563	564	Oct	1681291	1.00	1.68	1.32
564	565	Oct	1570368	0.99	1.78	1.31
565	566	Nov	1570216	1.00	1.76	1.21
566	567	Nov	1737014	0.97	1.86	1.30
567	568	Nov	1428985	1.06	1.75	1.31

568	569	Nov	1076198	1.10	1.77	1.38
569	570	Dec	1523707	1.00	1.83	1.31
570	571	Dec	1579472	1.00	1.88	1.28
571	572	Dec	1223610	1.07	1.85	1.25
572	573	Dec	1092610	1.04	1.90	1.40

	LNWEEK	Jan	Feb	Mar	...	Oct	Nov	\
0	0.000000	1	0	0	...	0	0	
1	0.693147	1	0	0	...	0	0	
2	1.098612	1	0	0	...	0	0	
3	1.386294	1	0	0	...	0	0	
4	1.609438	0	1	0	...	0	0	
5	1.791759	0	1	0	...	0	0	
6	1.945910	0	1	0	...	0	0	
7	2.079442	0	1	0	...	0	0	
8	2.197225	0	0	1	...	0	0	
9	2.302585	0	0	1	...	0	0	
10	2.397895	0	0	1	...	0	0	
11	2.484907	0	0	1	...	0	0	
12	2.564949	0	0	1	...	0	0	
13	2.639057	0	0	0	...	0	0	
14	2.708050	0	0	0	...	0	0	
15	2.772589	0	0	0	...	0	0	
16	2.833213	0	0	0	...	0	0	
17	2.890372	0	0	0	...	0	0	
18	2.944439	0	0	0	...	0	0	
19	2.995732	0	0	0	...	0	0	
20	3.044522	0	0	0	...	0	0	
21	3.091042	0	0	0	...	0	0	
22	3.135494	0	0	0	...	0	0	
23	3.178054	0	0	0	...	0	0	
24	3.218876	0	0	0	...	0	0	
25	3.258097	0	0	0	...	0	0	
26	3.295837	0	0	0	...	0	0	
27	3.332205	0	0	0	...	0	0	
28	3.367296	0	0	0	...	0	0	
29	3.401197	0	0	0	...	0	0	
..	...	...	...	...	...	...	...	
543	6.298949	0	0	0	...	0	0	
544	6.300786	0	0	0	...	0	0	
545	6.302619	0	0	0	...	0	0	
546	6.304449	0	0	0	...	0	0	
547	6.306275	0	0	0	...	0	0	
548	6.308098	0	0	0	...	0	0	
549	6.309918	0	0	0	...	0	0	
550	6.311735	0	0	0	...	0	0	
551	6.313548	0	0	0	...	0	0	
552	6.315358	0	0	0	...	0	0	

553	6.317165	0	0	0	...	0	0
554	6.318968	0	0	0	...	0	0
555	6.320768	0	0	0	...	0	0
556	6.322565	0	0	0	...	0	0
557	6.324359	0	0	0	...	0	0
558	6.326149	0	0	0	...	0	0
559	6.327937	0	0	0	...	0	0
560	6.329721	0	0	0	...	0	0
561	6.331502	0	0	0	...	1	0
562	6.333280	0	0	0	...	1	0
563	6.335054	0	0	0	...	1	0
564	6.336826	0	0	0	...	1	0
565	6.338594	0	0	0	...	0	1
566	6.340359	0	0	0	...	0	1
567	6.342121	0	0	0	...	0	1
568	6.343880	0	0	0	...	0	1
569	6.345636	0	0	0	...	0	0
570	6.347389	0	0	0	...	0	0
571	6.349139	0	0	0	...	0	0
572	6.350886	0	0	0	...	0	0

	Monthly Dummy Effects	PREDICTED YOPLAIT UNITS	95PI_L	\
0	416788.905078	1.353762e+06	1.018292e+06	
1	416788.905078	1.282463e+06	9.469929e+05	
2	416788.905078	1.223484e+06	8.880141e+05	
3	416788.905078	1.318253e+06	9.827834e+05	
4	457736.148745	1.437371e+06	1.101901e+06	
5	457736.148745	1.190714e+06	8.552444e+05	
6	457736.148745	1.223827e+06	8.883572e+05	
7	457736.148745	1.163529e+06	8.280593e+05	
8	476321.069384	1.376947e+06	1.041477e+06	
9	476321.069384	1.479659e+06	1.144189e+06	
10	476321.069384	1.307870e+06	9.724003e+05	
11	476321.069384	1.162175e+06	8.267052e+05	
12	476321.069384	1.348654e+06	1.013184e+06	
13	426062.711488	1.432007e+06	1.096537e+06	
14	426062.711488	1.233962e+06	8.984920e+05	
15	426062.711488	1.319776e+06	9.843062e+05	
16	426062.711488	1.025412e+06	6.899423e+05	
17	420077.724684	1.300532e+06	9.650618e+05	
18	420077.724684	1.000301e+06	6.648313e+05	
19	420077.724684	1.345669e+06	1.010199e+06	
20	420077.724684	1.150087e+06	8.146169e+05	
21	420077.724684	1.411789e+06	1.076319e+06	
22	363990.520966	1.441580e+06	1.106110e+06	
23	363990.520966	1.457945e+06	1.122475e+06	
24	363990.520966	1.329518e+06	9.940485e+05	
25	363990.520966	1.168247e+06	8.327772e+05	

26	343386.604344	1.286010e+06	9.505403e+05
27	343386.604344	1.108979e+06	7.735092e+05
28	343386.604344	1.336291e+06	1.000821e+06
29	343386.604344	1.303390e+06	9.679198e+05
..	...	...	...
543	363990.520966	2.304337e+06	1.968868e+06
544	363990.520966	1.783628e+06	1.448158e+06
545	363990.520966	1.949081e+06	1.613611e+06
546	363990.520966	2.054847e+06	1.719377e+06
547	363990.520966	2.055276e+06	1.719806e+06
548	343386.604344	1.683154e+06	1.347684e+06
549	343386.604344	1.944131e+06	1.608661e+06
550	343386.604344	2.120057e+06	1.784587e+06
551	343386.604344	1.675670e+06	1.340200e+06
552	406551.827621	1.895336e+06	1.559867e+06
553	406551.827621	1.826871e+06	1.491402e+06
554	406551.827621	1.921493e+06	1.586023e+06
555	406551.827621	1.538841e+06	1.203372e+06
556	453551.117530	1.663405e+06	1.327935e+06
557	453551.117530	1.953323e+06	1.617853e+06
558	453551.117530	1.502734e+06	1.167264e+06
559	453551.117530	1.621845e+06	1.286375e+06
560	453551.117530	1.797625e+06	1.462155e+06
561	349466.722548	1.756406e+06	1.420936e+06
562	349466.722548	1.665006e+06	1.329536e+06
563	349466.722548	1.638658e+06	1.303188e+06
564	349466.722548	1.687505e+06	1.352035e+06
565	139042.340772	1.407089e+06	1.071620e+06
566	139042.340772	1.567662e+06	1.232192e+06
567	139042.340772	1.174013e+06	8.385433e+05
568	139042.340772	1.021538e+06	6.860678e+05
569	0.000000	1.300384e+06	9.649145e+05
570	0.000000	1.297013e+06	9.615429e+05
571	0.000000	9.857110e+05	6.502412e+05
572	0.000000	1.157605e+06	8.221350e+05

	95PI_U	MAPE	Own_elasticity	Cross_elasticity($Dannon)	\
0	1.689232e+06	0.054497	-2.417886	0.061907	
1	1.617933e+06	0.172339	-2.686642	0.059066	
2	1.558954e+06	0.155429	-2.921759	0.067182	
3	1.653723e+06	0.057051	-2.679043	0.067243	
4	1.772841e+06	0.058017	-2.427062	0.061670	
5	1.526184e+06	0.095027	-3.146852	0.060233	
6	1.559297e+06	0.019325	-3.061708	0.065846	
7	1.498999e+06	0.035267	-3.294408	0.073414	
8	1.712417e+06	0.106925	-2.658682	0.064962	
9	1.815128e+06	0.009363	-2.415912	0.060452	
10	1.643340e+06	0.035206	-2.864964	0.057302	

11	1.497645e+06	0.112325	-3.372364	0.075580
12	1.684123e+06	0.015895	-2.778327	0.066324
13	1.767477e+06	0.044647	-2.526380	0.057399
14	1.569432e+06	0.065928	-3.106368	0.071836
15	1.655246e+06	0.096451	-2.839119	0.059227
16	1.360882e+06	0.170780	-3.948153	0.073872
17	1.636001e+06	0.129235	-2.914247	0.068779
18	1.335771e+06	0.207803	-4.090322	0.082171
19	1.681139e+06	0.014702	-2.784490	0.055692
20	1.485557e+06	0.104254	-3.445259	0.075674
21	1.747259e+06	0.028150	-2.623573	0.058792
22	1.777050e+06	0.070013	-2.509604	0.052546
23	1.793415e+06	0.032629	-2.481435	0.058589
24	1.664988e+06	0.040832	-2.818315	0.060006
25	1.503717e+06	0.008360	-3.354836	0.072428
26	1.621480e+06	0.021083	-2.947154	0.068302
27	1.444449e+06	0.056291	-3.572968	0.069759
28	1.671761e+06	0.019560	-2.804032	0.062717
29	1.638859e+06	0.030797	-2.907857	0.068009
..	...	...	...	...
543	2.639807e+06	0.210299	-1.588684	0.054554
544	2.119098e+06	0.077968	-2.342244	0.069577
545	2.284551e+06	0.122084	-2.055028	0.058710
546	2.390317e+06	0.167754	-1.907333	0.065100
547	2.390746e+06	0.176956	-1.906935	0.063910
548	2.018624e+06	0.041794	-2.533237	0.073731
549	2.279600e+06	0.050188	-2.060261	0.066320
550	2.455527e+06	0.116807	-1.808036	0.061197
551	2.011140e+06	0.110118	-2.544551	0.072136
552	2.230806e+06	0.008680	-2.158748	0.070153
553	2.162341e+06	0.098157	-2.286801	0.069695
554	2.256963e+06	0.028925	-2.129362	0.069198
555	1.874311e+06	0.034605	-2.882757	0.086405
556	1.998874e+06	0.030770	-2.640991	0.078966
557	2.288792e+06	0.039176	-2.094663	0.066421
558	1.838204e+06	0.138970	-3.038005	0.087945
559	1.957315e+06	0.034522	-2.735221	0.082977
560	2.133095e+06	0.002612	-2.371924	0.076656
561	2.091876e+06	0.070720	-2.378545	0.075244
562	2.000476e+06	0.102403	-2.560849	0.083730
563	1.974127e+06	0.025357	-2.628309	0.082617
564	2.022975e+06	0.074592	-2.526706	0.085001
565	1.742559e+06	0.103888	-3.060856	0.100796
566	1.903132e+06	0.097496	-2.664918	0.095612
567	1.509483e+06	0.178429	-3.888638	0.120120
568	1.357007e+06	0.050790	-4.637703	0.139627
569	1.635854e+06	0.146565	-3.312019	0.113404
570	1.632483e+06	0.178831	-3.320629	0.116806

571	1.321181e+06	0.194424	-4.675185	0.151242
572	1.493075e+06	0.059486	-3.869347	0.132265

	Cross_elasticity($Chobani)
0	0.000000
1	0.000000
2	0.000000
3	0.000000
4	0.000000
5	0.000000
6	0.000000
7	0.000000
8	0.000000
9	0.000000
10	0.000000
11	0.000000
12	0.000000
13	0.000000
14	0.000000
15	0.000000
16	0.000000
17	0.000000
18	0.000000
19	0.000000
20	0.000000
21	0.000000
22	0.000000
23	0.000000
24	0.000000
25	0.000000
26	0.000000
27	0.000000
28	0.000000
29	0.000000
..	...
543	0.155463
544	0.199414
545	0.183799
546	0.174339
547	0.175548
548	0.214359
549	0.184267
550	0.170183
551	0.212262
552	0.172810
553	0.191893
554	0.183775
555	0.204530

```
556                    0.210750
557                    0.174230
558                    0.240095
559                    0.214573
560                    0.193591
561                    0.187936
562                    0.190569
563                    0.206125
564                    0.198642
565                    0.220044
566                    0.212196
567                    0.285525
568                    0.345677
569                    0.257778
570                    0.252529
571                    0.324494
572                    0.309466

[573 rows x 26 columns]
```

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

Out[18]:

	WEEK	MONTH	YOPLAIT_UNITS	YOPLAIT_PRICE	DANNON_PRICE	CHOBANI_PRICE	\
0	1	Jan	1431790	0.76	1.04	0.0	
1	2	Jan	1549503	0.80	0.94	0.0	
2	3	Jan	1448646	0.83	1.02	0.0	
3	4	Jan	1398011	0.82	1.10	0.0	
4	5	Feb	1525899	0.81	1.10	0.0	
5	6	Feb	1315745	0.87	0.89	0.0	
6	7	Feb	1247943	0.87	1.00	0.0	
7	8	Feb	1206063	0.89	1.06	0.0	
8	9	Mar	1541804	0.85	1.11	0.0	
9	10	Mar	1493644	0.83	1.11	0.0	
10	11	Mar	1355595	0.87	0.93	0.0	
11	12	Mar	1309235	0.91	1.09	0.0	
12	13	Mar	1370437	0.87	1.11	0.0	
13	14	Apr	1498930	0.84	1.02	0.0	
14	15	Apr	1321056	0.89	1.10	0.0	
15	16	Apr	1203680	0.87	0.97	0.0	
16	17	Apr	1236598	0.94	0.94	0.0	
17	18	May	1493550	0.88	1.11	0.0	
18	19	May	1262692	0.95	1.02	0.0	
19	20	May	1365748	0.87	0.93	0.0	
20	21	May	1283943	0.92	1.08	0.0	
21	22	May	1373136	0.86	1.03	0.0	
22	23	Jun	1550108	0.84	0.94	0.0	
23	24	Jun	1411876	0.84	1.06	0.0	

24	25	Jun	1277361	0.87	0.99	0.0
25	26	Jun	1158561	0.91	1.05	0.0
26	27	Jul	1259457	0.88	1.09	0.0
27	28	Jul	1175128	0.92	0.96	0.0
28	29	Jul	1310654	0.87	1.04	0.0
29	30	Jul	1264448	0.88	1.10	0.0
..	...	...	...	...	...	...
325	326	Mar	2010947	0.82	1.15	0.0
326	327	Apr	2072191	0.83	1.33	0.0
327	328	Apr	1860287	0.84	1.20	0.0
328	329	Apr	2308603	0.75	1.17	0.0
329	330	Apr	2085048	0.81	1.14	0.0
330	331	May	2328731	0.77	1.17	0.0
331	332	May	2594268	0.73	1.24	0.0
332	333	May	2053628	0.80	1.18	0.0
333	334	May	2028639	0.79	1.28	0.0
334	335	May	2180713	0.77	1.19	0.0
335	336	Jun	2346057	0.74	1.15	0.0
336	337	Jun	2223429	0.76	1.23	0.0
337	338	Jun	2076794	0.76	1.22	0.0
338	339	Jun	1869966	0.82	1.28	0.0
339	340	Jul	1790525	0.83	1.26	0.0
340	341	Jul	2035924	0.81	1.41	0.0
341	342	Jul	1884044	0.81	1.20	0.0
342	343	Jul	2308044	0.72	1.45	0.0
343	344	Aug	2038505	0.81	1.38	0.0
344	345	Aug	1979502	0.84	1.19	0.0
345	346	Aug	2241296	0.79	1.31	0.0
346	347	Aug	2392656	0.77	1.47	0.0
347	348	Aug	1971806	0.87	1.46	0.0
348	349	Sep	2201017	0.86	1.23	0.0
349	350	Sep	2187952	0.86	1.34	0.0
350	351	Sep	2323594	0.81	1.42	0.0
351	352	Sep	2482849	0.77	1.40	0.0
352	353	Oct	2543017	0.79	1.34	0.0
353	354	Oct	2479046	0.79	1.42	0.0
354	355	Oct	2286465	0.81	1.31	0.0

	LNWEEK	Jan	Feb	Mar	...	Oct	Nov	\
0	0.000000	1	0	0	...	0	0	
1	0.693147	1	0	0	...	0	0	
2	1.098612	1	0	0	...	0	0	
3	1.386294	1	0	0	...	0	0	
4	1.609438	0	1	0	...	0	0	
5	1.791759	0	1	0	...	0	0	
6	1.945910	0	1	0	...	0	0	
7	2.079442	0	1	0	...	0	0	
8	2.197225	0	0	1	...	0	0	

9	2.302585	0	0	1	...	0	0
10	2.397895	0	0	1	...	0	0
11	2.484907	0	0	1	...	0	0
12	2.564949	0	0	1	...	0	0
13	2.639057	0	0	0	...	0	0
14	2.708050	0	0	0	...	0	0
15	2.772589	0	0	0	...	0	0
16	2.833213	0	0	0	...	0	0
17	2.890372	0	0	0	...	0	0
18	2.944439	0	0	0	...	0	0
19	2.995732	0	0	0	...	0	0
20	3.044522	0	0	0	...	0	0
21	3.091042	0	0	0	...	0	0
22	3.135494	0	0	0	...	0	0
23	3.178054	0	0	0	...	0	0
24	3.218876	0	0	0	...	0	0
25	3.258097	0	0	0	...	0	0
26	3.295837	0	0	0	...	0	0
27	3.332205	0	0	0	...	0	0
28	3.367296	0	0	0	...	0	0
29	3.401197	0	0	0	...	0	0
..	...	...	...	...	...	...	...
325	5.786897	0	0	1	...	0	0
326	5.789960	0	0	0	...	0	0
327	5.793014	0	0	0	...	0	0
328	5.796058	0	0	0	...	0	0
329	5.799093	0	0	0	...	0	0
330	5.802118	0	0	0	...	0	0
331	5.805135	0	0	0	...	0	0
332	5.808142	0	0	0	...	0	0
333	5.811141	0	0	0	...	0	0
334	5.814131	0	0	0	...	0	0
335	5.817111	0	0	0	...	0	0
336	5.820083	0	0	0	...	0	0
337	5.823046	0	0	0	...	0	0
338	5.826000	0	0	0	...	0	0
339	5.828946	0	0	0	...	0	0
340	5.831882	0	0	0	...	0	0
341	5.834811	0	0	0	...	0	0
342	5.837730	0	0	0	...	0	0
343	5.840642	0	0	0	...	0	0
344	5.843544	0	0	0	...	0	0
345	5.846439	0	0	0	...	0	0
346	5.849325	0	0	0	...	0	0
347	5.852202	0	0	0	...	0	0
348	5.855072	0	0	0	...	0	0
349	5.857933	0	0	0	...	0	0
350	5.860786	0	0	0	...	0	0

```
351  5.863631    0    0    0             ...                 0    0
352  5.866468    0    0    0             ...                 1    0
353  5.869297    0    0    0             ...                 1    0
354  5.872118    0    0    0             ...                 1    0

     Monthly Dummy Effects  PREDICTED YOPLAIT UNITS        95PI_L  \
0            416788.905078             1.353762e+06  1.018292e+06
1            416788.905078             1.282463e+06  9.469929e+05
2            416788.905078             1.223484e+06  8.880141e+05
3            416788.905078             1.318253e+06  9.827834e+05
4            457736.148745             1.437371e+06  1.101901e+06
5            457736.148745             1.190714e+06  8.552444e+05
6            457736.148745             1.223827e+06  8.883572e+05
7            457736.148745             1.163529e+06  8.280593e+05
8            476321.069384             1.376947e+06  1.041477e+06
9            476321.069384             1.479659e+06  1.144189e+06
10           476321.069384             1.307870e+06  9.724003e+05
11           476321.069384             1.162175e+06  8.267052e+05
12           476321.069384             1.348654e+06  1.013184e+06
13           426062.711488             1.432007e+06  1.096537e+06
14           426062.711488             1.233962e+06  8.984920e+05
15           426062.711488             1.319776e+06  9.843062e+05
16           426062.711488             1.025412e+06  6.899423e+05
17           420077.724684             1.300532e+06  9.650618e+05
18           420077.724684             1.000301e+06  6.648313e+05
19           420077.724684             1.345669e+06  1.010199e+06
20           420077.724684             1.150087e+06  8.146169e+05
21           420077.724684             1.411789e+06  1.076319e+06
22           363990.520966             1.441580e+06  1.106110e+06
23           363990.520966             1.457945e+06  1.122475e+06
24           363990.520966             1.329518e+06  9.940485e+05
25           363990.520966             1.168247e+06  8.327772e+05
26           343386.604344             1.286010e+06  9.505403e+05
27           343386.604344             1.108979e+06  7.735092e+05
28           343386.604344             1.336291e+06  1.000821e+06
29           343386.604344             1.303390e+06  9.679198e+05
..                     ...                      ...           ...
325          476321.069384             2.074048e+06  1.738578e+06
326          426062.711488             1.995707e+06  1.660238e+06
327          426062.711488             1.942643e+06  1.607173e+06
328          426062.711488             2.328325e+06  1.992855e+06
329          426062.711488             2.067971e+06  1.732501e+06
330          420077.724684             2.237155e+06  1.901685e+06
331          420077.724684             2.415547e+06  2.080077e+06
332          420077.724684             2.109702e+06  1.774232e+06
333          420077.724684             2.161301e+06  1.825831e+06
334          420077.724684             2.240657e+06  1.905187e+06
335          363990.520966             2.311022e+06  1.975552e+06
```

336	363990.520966	2.231798e+06	1.896328e+06
337	363990.520966	2.231458e+06	1.895988e+06
338	363990.520966	1.978344e+06	1.642874e+06
339	343386.604344	1.913523e+06	1.578053e+06
340	343386.604344	2.012211e+06	1.676741e+06
341	343386.604344	1.995748e+06	1.660279e+06
342	343386.604344	2.403975e+06	2.068505e+06
343	406551.827621	2.074336e+06	1.738866e+06
344	406551.827621	1.930275e+06	1.594805e+06
345	406551.827621	2.155745e+06	1.820275e+06
346	406551.827621	2.255230e+06	1.919761e+06
347	406551.827621	1.824187e+06	1.488718e+06
348	453551.117530	1.896173e+06	1.560703e+06
349	453551.117530	1.905487e+06	1.570017e+06
350	453551.117530	2.127728e+06	1.792258e+06
351	453551.117530	2.298839e+06	1.963370e+06
352	349466.722548	2.104228e+06	1.768758e+06
353	349466.722548	2.111120e+06	1.775650e+06
354	349466.722548	2.016561e+06	1.681092e+06

	95PI_U	MAPE	Own_elasticity	Cross_elasticity($Dannon)	\
0	1.689232e+06	0.054497	-2.417886	0.061907	
1	1.617933e+06	0.172339	-2.686642	0.059066	
2	1.558954e+06	0.155429	-2.921759	0.067182	
3	1.653723e+06	0.057051	-2.679043	0.067243	
4	1.772841e+06	0.058017	-2.427062	0.061670	
5	1.526184e+06	0.095027	-3.146852	0.060233	
6	1.559297e+06	0.019325	-3.061708	0.065846	
7	1.498999e+06	0.035267	-3.294408	0.073414	
8	1.712417e+06	0.106925	-2.658682	0.064962	
9	1.815128e+06	0.009363	-2.415912	0.060452	
10	1.643340e+06	0.035206	-2.864964	0.057302	
11	1.497645e+06	0.112325	-3.372364	0.075580	
12	1.684123e+06	0.015895	-2.778327	0.066324	
13	1.767477e+06	0.044647	-2.526380	0.057399	
14	1.569432e+06	0.065928	-3.106368	0.071836	
15	1.655246e+06	0.096451	-2.839119	0.059227	
16	1.360882e+06	0.170780	-3.948153	0.073872	
17	1.636001e+06	0.129235	-2.914247	0.068779	
18	1.335771e+06	0.207803	-4.090322	0.082171	
19	1.681139e+06	0.014702	-2.784490	0.055692	
20	1.485557e+06	0.104254	-3.445259	0.075674	
21	1.747259e+06	0.028150	-2.623573	0.058792	
22	1.777050e+06	0.070013	-2.509604	0.052546	
23	1.793415e+06	0.032629	-2.481435	0.058589	
24	1.664988e+06	0.040832	-2.818315	0.060006	
25	1.503717e+06	0.008360	-3.354836	0.072428	
26	1.621480e+06	0.021083	-2.947154	0.068302	

27	1.444449e+06	0.056291	-3.572968	0.069759
28	1.671761e+06	0.019560	-2.804032	0.062717
29	1.638859e+06	0.030797	-2.907857	0.068009
..	...	...	...	...
325	2.409518e+06	0.031379	-1.702785	0.044682
326	2.331177e+06	0.036910	-1.791207	0.053704
327	2.278113e+06	0.044270	-1.862306	0.049778
328	2.663795e+06	0.008543	-1.387338	0.040494
329	2.403441e+06	0.008190	-1.686962	0.044423
330	2.572625e+06	0.039324	-1.482379	0.042144
331	2.751016e+06	0.068891	-1.301584	0.041367
332	2.445172e+06	0.027305	-1.633178	0.045073
333	2.496771e+06	0.065395	-1.574260	0.047725
334	2.576126e+06	0.027488	-1.480062	0.042798
335	2.646492e+06	0.014934	-1.379089	0.040100
336	2.567268e+06	0.003764	-1.466639	0.044412
337	2.566928e+06	0.074473	-1.466863	0.044058
338	2.313814e+06	0.057957	-1.785158	0.052139
339	2.248993e+06	0.068694	-1.868138	0.053063
340	2.347680e+06	0.011648	-1.733709	0.056467
341	2.331218e+06	0.059290	-1.748010	0.048454
342	2.739444e+06	0.041564	-1.289933	0.048606
343	2.409806e+06	0.017577	-1.681785	0.053611
344	2.265745e+06	0.024869	-1.874238	0.049680
345	2.491215e+06	0.038170	-1.578317	0.048969
346	2.590700e+06	0.057436	-1.470498	0.052526
347	2.159657e+06	0.074865	-2.054066	0.064496
348	2.231643e+06	0.138502	-1.953373	0.052273
349	2.240957e+06	0.129100	-1.943824	0.056670
350	2.463197e+06	0.084295	-1.639584	0.053780
351	2.634309e+06	0.074112	-1.442603	0.049076
352	2.439698e+06	0.172547	-1.616958	0.051317
353	2.446590e+06	0.148414	-1.611680	0.054203
354	2.352031e+06	0.118044	-1.729968	0.052349

	Cross_elasticity($Chobani)
0	0.0
1	0.0
2	0.0
3	0.0
4	0.0
5	0.0
6	0.0
7	0.0
8	0.0
9	0.0
10	0.0
11	0.0

12	0.0
13	0.0
14	0.0
15	0.0
16	0.0
17	0.0
18	0.0
19	0.0
20	0.0
21	0.0
22	0.0
23	0.0
24	0.0
25	0.0
26	0.0
27	0.0
28	0.0
29	0.0
..	...
325	0.0
326	0.0
327	0.0
328	0.0
329	0.0
330	0.0
331	0.0
332	0.0
333	0.0
334	0.0
335	0.0
336	0.0
337	0.0
338	0.0
339	0.0
340	0.0
341	0.0
342	0.0
343	0.0
344	0.0
345	0.0
346	0.0
347	0.0
348	0.0
349	0.0
350	0.0
351	0.0
352	0.0
353	0.0

```
354                          0.0

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

545	546	Jun	1737019	0.93	1.42	1.40
546	547	Jun	1759658	0.91	1.66	1.40
547	548	Jun	1746264	0.91	1.63	1.41
548	549	Jul	1615631	0.99	1.54	1.41
549	550	Jul	1851221	0.93	1.60	1.40
550	551	Jul	1898320	0.89	1.61	1.41
551	552	Jul	1509453	0.99	1.50	1.39
552	553	Aug	1879026	0.95	1.65	1.28
553	554	Aug	2025709	0.97	1.58	1.37
554	555	Aug	1867477	0.95	1.65	1.38
555	556	Aug	1594002	1.03	1.65	1.23
556	557	Sep	1613750	1.02	1.63	1.37
557	558	Sep	2032965	0.95	1.61	1.33
558	559	Sep	1745274	1.06	1.64	1.41
559	560	Sep	1679836	1.03	1.67	1.36
560	561	Sep	1792941	0.99	1.71	1.36
561	562	Oct	1890071	0.97	1.64	1.29
562	563	Oct	1854960	0.99	1.73	1.24
563	564	Oct	1681291	1.00	1.68	1.32
564	565	Oct	1570368	0.99	1.78	1.31
565	566	Nov	1570216	1.00	1.76	1.21
566	567	Nov	1737014	0.97	1.86	1.30
567	568	Nov	1428985	1.06	1.75	1.31
568	569	Nov	1076198	1.10	1.77	1.38
569	570	Dec	1523707	1.00	1.83	1.31
570	571	Dec	1579472	1.00	1.88	1.28
571	572	Dec	1223610	1.07	1.85	1.25
572	573	Dec	1092610	1.04	1.90	1.40

	LNWEEK	Jan	Feb	Mar	...	Oct	Nov	\
355	5.874931	0	0	0	...	1	0	
356	5.877736	0	0	0	...	0	1	
357	5.880533	0	0	0	...	0	1	
358	5.883322	0	0	0	...	0	1	
359	5.886104	0	0	0	...	0	1	
360	5.888878	0	0	0	...	0	1	
361	5.891644	0	0	0	...	0	0	
362	5.894403	0	0	0	...	0	0	
363	5.897154	0	0	0	...	0	0	
364	5.899897	0	0	0	...	0	0	
365	5.902633	1	0	0	...	0	0	
366	5.905362	1	0	0	...	0	0	
367	5.908083	1	0	0	...	0	0	
368	5.910797	1	0	0	...	0	0	
369	5.913503	1	0	0	...	0	0	
370	5.916202	0	1	0	...	0	0	
371	5.918894	0	1	0	...	0	0	
372	5.921578	0	1	0	...	0	0	

373	5.924256	0	1	0	...	0	0
374	5.926926	0	0	1	...	0	0
375	5.929589	0	0	1	...	0	0
376	5.932245	0	0	1	...	0	0
377	5.934894	0	0	1	...	0	0
378	5.937536	0	0	0	...	0	0
379	5.940171	0	0	0	...	0	0
380	5.942799	0	0	0	...	0	0
381	5.945421	0	0	0	...	0	0
382	5.948035	0	0	0	...	0	0
383	5.950643	0	0	0	...	0	0
384	5.953243	0	0	0	...	0	0
..	...	...	...	...	...	...	...
543	6.298949	0	0	0	...	0	0
544	6.300786	0	0	0	...	0	0
545	6.302619	0	0	0	...	0	0
546	6.304449	0	0	0	...	0	0
547	6.306275	0	0	0	...	0	0
548	6.308098	0	0	0	...	0	0
549	6.309918	0	0	0	...	0	0
550	6.311735	0	0	0	...	0	0
551	6.313548	0	0	0	...	0	0
552	6.315358	0	0	0	...	0	0
553	6.317165	0	0	0	...	0	0
554	6.318968	0	0	0	...	0	0
555	6.320768	0	0	0	...	0	0
556	6.322565	0	0	0	...	0	0
557	6.324359	0	0	0	...	0	0
558	6.326149	0	0	0	...	0	0
559	6.327937	0	0	0	...	0	0
560	6.329721	0	0	0	...	0	0
561	6.331502	0	0	0	...	1	0
562	6.333280	0	0	0	...	1	0
563	6.335054	0	0	0	...	1	0
564	6.336826	0	0	0	...	1	0
565	6.338594	0	0	0	...	0	1
566	6.340359	0	0	0	...	0	1
567	6.342121	0	0	0	...	0	1
568	6.343880	0	0	0	...	0	1
569	6.345636	0	0	0	...	0	0
570	6.347389	0	0	0	...	0	0
571	6.349139	0	0	0	...	0	0
572	6.350886	0	0	0	...	0	0

	Monthly Dummy Effects	PREDICTED YOPLAIT UNITS	95PI_L	\
355	349466.722548	2.301102e+06	1.965632e+06	
356	139042.340772	2.186453e+06	1.850983e+06	
357	139042.340772	2.033194e+06	1.697724e+06	

358	139042.340772	1.878031e+06	1.542561e+06
359	139042.340772	1.923963e+06	1.588493e+06
360	139042.340772	2.265720e+06	1.930250e+06
361	0.000000	1.785353e+06	1.449883e+06
362	0.000000	2.018902e+06	1.683433e+06
363	0.000000	1.827543e+06	1.492073e+06
364	0.000000	1.866732e+06	1.531262e+06
365	416788.905078	3.081310e+06	2.745840e+06
366	416788.905078	3.125797e+06	2.790327e+06
367	416788.905078	2.580975e+06	2.245505e+06
368	416788.905078	2.374780e+06	2.039310e+06
369	416788.905078	2.507636e+06	2.172166e+06
370	457736.148745	2.348287e+06	2.012817e+06
371	457736.148745	2.574447e+06	2.238977e+06
372	457736.148745	2.439215e+06	2.103746e+06
373	457736.148745	2.477828e+06	2.142359e+06
374	476321.069384	2.229173e+06	1.893704e+06
375	476321.069384	2.767307e+06	2.431837e+06
376	476321.069384	2.488099e+06	2.152629e+06
377	476321.069384	2.182523e+06	1.847053e+06
378	426062.711488	2.171827e+06	1.836357e+06
379	426062.711488	2.095143e+06	1.759673e+06
380	426062.711488	2.342329e+06	2.006860e+06
381	426062.711488	2.605086e+06	2.269616e+06
382	420077.724684	2.537958e+06	2.202488e+06
383	420077.724684	2.397223e+06	2.061753e+06
384	420077.724684	2.504905e+06	2.169435e+06
..	...	...	...
543	363990.520966	2.304337e+06	1.968868e+06
544	363990.520966	1.783628e+06	1.448158e+06
545	363990.520966	1.949081e+06	1.613611e+06
546	363990.520966	2.054847e+06	1.719377e+06
547	363990.520966	2.055276e+06	1.719806e+06
548	343386.604344	1.683154e+06	1.347684e+06
549	343386.604344	1.944131e+06	1.608661e+06
550	343386.604344	2.120057e+06	1.784587e+06
551	343386.604344	1.675670e+06	1.340200e+06
552	406551.827621	1.895336e+06	1.559867e+06
553	406551.827621	1.826871e+06	1.491402e+06
554	406551.827621	1.921493e+06	1.586023e+06
555	406551.827621	1.538841e+06	1.203372e+06
556	453551.117530	1.663405e+06	1.327935e+06
557	453551.117530	1.953323e+06	1.617853e+06
558	453551.117530	1.502734e+06	1.167264e+06
559	453551.117530	1.621845e+06	1.286375e+06
560	453551.117530	1.797625e+06	1.462155e+06
561	349466.722548	1.756406e+06	1.420936e+06
562	349466.722548	1.665006e+06	1.329536e+06

563	349466.722548	1.638658e+06	1.303188e+06	
564	349466.722548	1.687505e+06	1.352035e+06	
565	139042.340772	1.407089e+06	1.071620e+06	
566	139042.340772	1.567662e+06	1.232192e+06	
567	139042.340772	1.174013e+06	8.385433e+05	
568	139042.340772	1.021538e+06	6.860678e+05	
569	0.000000	1.300384e+06	9.649145e+05	
570	0.000000	1.297013e+06	9.615429e+05	
571	0.000000	9.857110e+05	6.502412e+05	
572	0.000000	1.157605e+06	8.221350e+05	

	95PI_U	MAPE	Own_elasticity	Cross_elasticity($Dannon)	\
355	2.636571e+06	0.125827	-1.572201	0.048678	
356	2.521923e+06	0.029241	-1.634943	0.049387	
357	2.368664e+06	0.058788	-1.842914	0.054695	
358	2.213501e+06	0.047480	-2.063975	0.058785	
359	2.259433e+06	0.278592	-2.014700	0.062408	
360	2.601190e+06	0.043651	-1.539726	0.048371	
361	2.120823e+06	0.051751	-2.122869	0.063191	
362	2.354372e+06	0.006310	-1.770628	0.057078	
363	2.163013e+06	0.220374	-2.073861	0.066142	
364	2.202202e+06	0.403619	-2.007252	0.065185	
365	3.416780e+06	0.067804	-0.950469	0.032691	
366	3.461267e+06	0.052087	-0.923163	0.026812	
367	2.916445e+06	0.037783	-1.334968	0.037155	
368	2.710250e+06	0.072619	-1.541559	0.045131	
369	2.843106e+06	0.017917	-1.408361	0.044026	
370	2.683756e+06	0.072089	-1.540610	0.042895	
371	2.909917e+06	0.003765	-1.355082	0.043822	
372	2.774685e+06	0.000783	-1.483180	0.043609	
373	2.813298e+06	0.048159	-1.442685	0.047157	
374	2.564643e+06	0.072128	-1.719534	0.044826	
375	3.102777e+06	0.054661	-1.151699	0.041351	
376	2.823569e+06	0.009058	-1.436729	0.048258	
377	2.517992e+06	0.042188	-1.736555	0.056861	
378	2.507296e+06	0.059630	-1.784769	0.051204	
379	2.430613e+06	0.060762	-1.870649	0.045386	
380	2.677799e+06	0.052855	-1.581303	0.054014	
381	2.940555e+06	0.083349	-1.322612	0.045163	
382	2.873428e+06	0.089824	-1.357595	0.047310	
383	2.732692e+06	0.067631	-1.509161	0.047062	
384	2.840375e+06	0.016967	-1.409896	0.046326	
..	...	...	...	...	
543	2.639807e+06	0.210299	-1.588684	0.054554	
544	2.119098e+06	0.077968	-2.342244	0.069577	
545	2.284551e+06	0.122084	-2.055028	0.058710	
546	2.390317e+06	0.167754	-1.907333	0.065100	
547	2.390746e+06	0.176956	-1.906935	0.063910	

548	2.018624e+06	0.041794	-2.533237	0.073731
549	2.279600e+06	0.050188	-2.060261	0.066320
550	2.455527e+06	0.116807	-1.808036	0.061197
551	2.011140e+06	0.110118	-2.544551	0.072136
552	2.230806e+06	0.008680	-2.158748	0.070153
553	2.162341e+06	0.098157	-2.286801	0.069695
554	2.256963e+06	0.028925	-2.129362	0.069198
555	1.874311e+06	0.034605	-2.882757	0.086405
556	1.998874e+06	0.030770	-2.640991	0.078966
557	2.288792e+06	0.039176	-2.094663	0.066421
558	1.838204e+06	0.138970	-3.038005	0.087945
559	1.957315e+06	0.034522	-2.735221	0.082977
560	2.133095e+06	0.002612	-2.371924	0.076656
561	2.091876e+06	0.070720	-2.378545	0.075244
562	2.000476e+06	0.102403	-2.560849	0.083730
563	1.974127e+06	0.025357	-2.628309	0.082617
564	2.022975e+06	0.074592	-2.526706	0.085001
565	1.742559e+06	0.103888	-3.060856	0.100796
566	1.903132e+06	0.097496	-2.664918	0.095612
567	1.509483e+06	0.178429	-3.888638	0.120120
568	1.357007e+06	0.050790	-4.637703	0.139627
569	1.635854e+06	0.146565	-3.312019	0.113404
570	1.632483e+06	0.178831	-3.320629	0.116806
571	1.321181e+06	0.194424	-4.675185	0.151242
572	1.493075e+06	0.059486	-3.869347	0.132265

	Cross_elasticity($Chobani)
355	0.176810
356	0.211828
357	0.235347
358	0.241166
359	0.254028
360	0.199900
361	0.229320
362	0.210396
363	0.242228
364	0.234401
365	0.142006
366	0.145715
367	0.177466
368	0.191797
369	0.181636
370	0.149285
371	0.168970
372	0.178338
373	0.169363
374	0.191698
375	0.110036

```
376                    0.163522
377                    0.143036
378                    0.207364
379                    0.206404
380                    0.184622
381                    0.170912
382                    0.150227
383                    0.175058
384                    0.174683
..                          ...
543                    0.155463
544                    0.199414
545                    0.183799
546                    0.174339
547                    0.175548
548                    0.214359
549                    0.184267
550                    0.170183
551                    0.212262
552                    0.172810
553                    0.191893
554                    0.183775
555                    0.204530
556                    0.210750
557                    0.174230
558                    0.240095
559                    0.214573
560                    0.193591
561                    0.187936
562                    0.190569
563                    0.206125
564                    0.198642
565                    0.220044
566                    0.212196
567                    0.285525
568                    0.345677
569                    0.257778
570                    0.252529
571                    0.324494
572                    0.309466

[218 rows x 26 columns]
```

```
In [22]: C2["Own_elasticity"].mean()
```

```
Out[22]: -1.7857630542663008
```

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

```
Out[23]: 0.05453197144187152

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

Out[24]: 0.16950989547367418

In [25]: D1=pd.DataFrame({'Before Chobani entry: % in unit sales of YOPLAIT':[-2.284,0.056,"N/A
                          'After Chobani entry: % in unit sales of YOPLAIT':[-1.786,0.055,0.17
                          'Price change':["1%_change_$YOPLAIT", "1%_change_$DANNON", "1%_chang
                          index=[1,2,3])
         D1=D1.set_index('Price change')
         D1

Out[25]:                    Before Chobani entry: % in unit sales of YOPLAIT  \
         Price change
         1%_change_$YOPLAIT                                             -2.284
         1%_change_$DANNON                                               0.056
         1%_change_$CHOBANI                                                N/A

                             After Chobani entry: % in unit sales of YOPLAIT
         Price change
         1%_change_$YOPLAIT                                             -1.786
         1%_change_$DANNON                                               0.055
         1%_change_$CHOBANI                                              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 estimated 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.

In [ ]: