In [2]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
import sklearn
import seaborn as sns
from datetime import datetime
from sklearn.model_selection import train_test_split
import statsmodels.formula.api as sm
import statsmodels.api as sm
from sklearn.linear_model import LinearRegression
```

In [3]:

```
# read the CSV file from system and assign variable name
df=pd.read_csv("Walmart.csv")
```

In [4]:

```
#Generate the first 5 row from the dataset
df.head()
```

Out[4]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment
0	1	5/2/2010	1643690.90	0	42.31	2.572	211.096358	8.106
1	1	12/2/2010	1641957.44	1	38.51	2.548	211.242170	8.106
2	1	19-02-2010	1611968.17	0	39.93	2.514	211.289143	8.106
3	1	26-02-2010	1409727.59	0	46.63	2.561	211.319643	8.106
4	1	5/3/2010	1554806.68	0	46.50	2.625	211.350143	8.106

Which store has maximum sales

In [5]:

```
#Get maximum value of all the columns
maxValuesObj = df.max()
print(maxValuesObj)
```

```
Store                   45
Date              9/9/2011
Weekly_Sales   3.81869e+06
Holiday_Flag             1
Temperature         100.14
Fuel_Price           4.468
CPI                227.233
Unemployment        14.313
dtype: object
```

In [ ]:

In [6]:

```
#Convert Weekly sales to Interger and Group the dataset by Store sum
df['Weekly_Sales'] = df['Weekly_Sales'].astype('int64')
max_store = df.groupby(['Store']).sum()
```

In [ ]:

In [7]:

```
#sort by Weekly sales in descending order
df_group=max_store.sort_values('Weekly_Sales', ascending= False)
df_group
```

Out[7]:

	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment
Store						
20	301397719	10	7929.55	488.718	29892.452680	1054.112
4	299543881	10	8902.23	460.027	18401.192733	852.951
14	288999841	10	8264.11	488.718	26638.851959	1236.771
13	286517633	10	7678.69	469.919	18401.192733	1001.261
2	275382373	10	9754.94	460.417	30837.422420	1090.210
10	271617645	10	10330.49	511.357	18401.192733	1195.904
27	253855845	10	8195.49	511.696	19878.613542	1144.250
6	223756059	10	9967.10	460.417	31110.107182	944.787
1	222402734	10	9767.87	460.417	30887.555523	1088.290
39	207445467	10	10095.42	460.417	30706.256907	1125.274
19	206634794	10	7478.19	511.696	19318.242848	1143.464
31	199613839	10	9845.21	460.417	30837.422420	1090.210
23	198750546	10	6979.13	492.169	19318.242848	685.830
24	194015953	10	7726.29	511.696	19318.242848	1207.923
11	193962721	10	10364.75	460.417	31372.988971	1026.309
28	189263612	10	10047.58	515.718	18401.192733	1875.657
41	181341863	10	6922.68	463.543	27693.986741	997.193
32	166819177	10	7542.90	463.543	27693.986741	1227.760
18	155114667	10	7632.09	492.169	19318.242848	1263.877
22	147075580	10	7850.29	492.169	19878.613542	1153.920
12	144287160	10	10047.58	515.718	18401.192733	1875.657
26	143416327	10	6243.13	492.169	19318.242848	1125.706
34	138249688	10	8364.91	460.027	18401.192733	1420.677
40	137870240	10	6817.46	492.169	19318.242848	685.830
35	131520601	10	8195.49	488.718	19878.613542	1256.766
8	129951115	10	8939.50	460.417	31379.780750	871.134
17	127782072	10	6633.37	469.919	18401.192733	936.565
45	112395273	10	8264.11	488.718	26638.851959	1236.771
21	108117810	10	9845.21	460.417	30837.422420	1090.210
25	101061103	10	7455.79	488.718	29892.452680	1054.112
43	90565366	10	9849.51	460.417	29706.128216	1420.677
15	89133609	10	7412.24	511.696	19318.242848	1143.464
7	81598205	10	5680.00	463.543	27693.986741	1227.760
42	79565685	10	10330.49	511.357	18401.192733	1195.904
9	77789152	10	9691.85	460.417	31406.616557	872.283
29	77141487	10	7850.29	492.169	19318.242848	1402.313
16	74252354	10	6439.30	463.543	27693.986741	926.353
37	74202669	10	10175.93	460.417	30706.256907	1125.274
30	62716810	10	9845.21	460.417	30837.422420	1090.210
3	57586666	10	10215.09	460.417	31372.988971	1026.309
38	55159554	10	10047.58	515.718	18401.192733	1875.657
36	53412139	10	10175.93	458.201	30706.256907	1125.274
5	45475617	10	9925.65	460.417	30968.878137	900.243
44	43293023	10	7678.69	469.919	18401.192733	963.194
33	37160150	10	10972.13	511.357	18401.192733	1220.241

In [8]:

```
#Get maximum value from the dataframe
maxSales=max(df_group['Weekly_Sales'])
maxSales
```

Out[8]:

```
301397719
```

ANSWER 1 :Store 20 has the maximum sales of 301397719

In [ ]:

```

```

Which store has maximum standard deviation i.e., the sales vary a lot. Also, find out the coefficient of mean to standard deviation

In [9]:

```
#get the Standard Deviation of the dataset
np.std(df)
```

Out[9]:

```
Store                12.987173
Weekly_Sales     564322.768257
Holiday_Flag          0.255029
Temperature          18.443500
Fuel_Price            0.458984
CPI                  39.353654
Unemployment          1.875739
dtype: float64
```

In [10]:

```
#Get the maximum Weekly Sales Standard Deviation
df_std=df.loc[df['Weekly_Sales'].idxmax()]
df_std
```

Out[10]:

```
Store                   14
Date            24-12-2010
Weekly_Sales       3818686
Holiday_Flag             0
Temperature          30.59
Fuel_Price           3.141
CPI                182.545
Unemployment         8.724
Name: 1905, dtype: object
```

Answer 2: Store 14 have the maximum standard deviation sales with 3818686

In [11]:

```
#Generate the Coeefficient of mean to Standard Deviation
mean=np.mean(df_group['Weekly_Sales'])
maxStd= np.std(df_group['Weekly_Sales'])
np.divide(maxStd,mean)
```

Out[11]:

```
0.5162721180867229
```

coefficient of mean to standard deviation is 0.5162721180867229

In [ ]:

```

```

In [ ]:

```

```

Which store/s has good quarterly growth rate in Q3’2012

In [12]:

```
#Create a variable consisting Date Store and Weekly Sales
Quart_Sales = df[["Date","Store", "Weekly_Sales"]]
Quart_Sales.head()
```

Out[12]:

	Date	Store	Weekly_Sales
0	5/2/2010	1	1643690
1	12/2/2010	1	1641957
2	19-02-2010	1	1611968
3	26-02-2010	1	1409727
4	5/3/2010	1	1554806

In [13]:

```
#Get the type
Quart_Sales.dtypes
```

Out[13]:

```
Date            object
Store            int64
Weekly_Sales     int64
dtype: object
```

In [14]:

```
#Convert Date column to Date and time
Quart_Sales['Date'] = pd.to_datetime(Quart_Sales["Date"])
Quart_Sales['Date']
```

```
C:\Users\cugagu\AppData\Local\Continuum\anaconda3\lib\site-packages\ipykernel_launcher.py:2: SettingWithCo
pyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html
#returning-a-view-versus-a-copy
```

Out[14]:

```
0      2010-05-02
1      2010-12-02
2      2010-02-19
3      2010-02-26
4      2010-05-03
          ...
6430   2012-09-28
6431   2012-05-10
6432   2012-12-10
6433   2012-10-19
6434   2012-10-26
Name: Date, Length: 6435, dtype: datetime64[ns]
```

In [15]:

```
#set Date as index for Quart_Sales
Quart_Sales=Quart_Sales.set_index('Date')
Quart_Sales.index
```

Out[15]:

```
DatetimeIndex(['2010-05-02', '2010-12-02', '2010-02-19', '2010-02-26',
               '2010-05-03', '2010-12-03', '2010-03-19', '2010-03-26',
               '2010-02-04', '2010-09-04',
               ...
               '2012-08-24', '2012-08-31', '2012-07-09', '2012-09-14',
               '2012-09-21', '2012-09-28', '2012-05-10', '2012-12-10',
               '2012-10-19', '2012-10-26'],
              dtype='datetime64[ns]', name='Date', length=6435, freq=None)
```

In [16]:

In [16]:

```
print(Quart_Sales)
```

```
            Store  Weekly_Sales
Date                           
2010-05-02      1       1643690
2010-12-02      1       1641957
2010-02-19      1       1611968
2010-02-26      1       1409727
2010-05-03      1       1554806
...           ...           ...
2012-09-28     45        713173
2012-05-10     45        733455
2012-12-10     45        734464
2012-10-19     45        718125
2012-10-26     45        760281

[6435 rows x 2 columns]
```

In [17]:

```
#Create Year
Quart_Sales['Year'] = Quart_Sales.index.year
Quart_Sales
```

Out[17]:

Date	Store	Weekly_Sales	Year
2010-05-02	1	1643690	2010
2010-12-02	1	1641957	2010
2010-02-19	1	1611968	2010
2010-02-26	1	1409727	2010
2010-05-03	1	1554806	2010
...	...	...	...
2012-09-28	45	713173	2012
2012-05-10	45	733455	2012
2012-12-10	45	734464	2012
2012-10-19	45	718125	2012
2012-10-26	45	760281	2012

6435 rows × 3 columns

In [18]:

```
#Get the  data with Year  2012
quart_2012=Quart_Sales.loc['2012']
quart_2012
```

Out[18]:

Date	Store	Weekly_Sales	Year
2012-06-01	1	1550369	2012
2012-01-13	1	1459601	2012
2012-01-20	1	1394393	2012
2012-01-27	1	1319325	2012
2012-03-02	1	1636339	2012
...	...	...	...
2012-09-28	45	713173	2012
2012-05-10	45	733455	2012
2012-12-10	45	734464	2012
2012-10-19	45	718125	2012
2012-10-26	45	760281	2012

1935 rows × 3 columns

In [19]:

```
#index Store
quart_2012.set_index("Store")
```

Out[19]:

	Weekly_Sales	Year
Store		
1	1550369	2012
1	1459601	2012
1	1394393	2012
1	1319325	2012
1	1636339	2012
...	...	...
45	713173	2012
45	733455	2012
45	734464	2012
45	718125	2012
45	760281	2012

1935 rows × 2 columns

In [20]:

```
#Group by Sumed Store ,Drop Year
max_quart = quart_2012.groupby(['Store']).sum()
quart_drop= max_quart.drop(['Year'], axis=1)
max_third=quart_drop.sort_values('Weekly_Sales', ascending= False)
max_third.head()
```

Out[20]:

	Weekly_Sales
Store	
4	92771166
20	89827688
13	86707435
2	81496678
10	78228596

Answer 3: Stores 4,20,13,2 and 10 have good quarterly growth rate in Q3' 2012

Some holidays have a negative impact on sales. Find out holidays which have higher sales than the mean sales in non-holiday season for all stores together

In [21]:

```
#Convert Date to datatime
df['Date']= pd.to_datetime(df['Date'])
```

In [22]:

```
#Generate the name of Months
months = []
months
for i in range (df.shape[0]):
    months.append (df['Date'][i].month)
```

```
Month_names = df['Date'].dt.month_name()
Month_names
```

Out[22]:

```
0             May
1        December
2        February
3        February
4             May
          ...
6430    September
6431          May
6432     December
6433      October
6434      October
Name: Date, Length: 6435, dtype: object
```

In [23]:

```
#Add Month Name to the dataset
df['Month_name'] = Month_names
df
```

Out[23]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment	Month_name
0	1	2010-05-02	1643690	0	42.31	2.572	211.096358	8.106	May
1	1	2010-12-02	1641957	1	38.51	2.548	211.242170	8.106	December
2	1	2010-02-19	1611968	0	39.93	2.514	211.289143	8.106	February
3	1	2010-02-26	1409727	0	46.63	2.561	211.319643	8.106	February
4	1	2010-05-03	1554806	0	46.50	2.625	211.350143	8.106	May
...	...	...	...	...	...	...	...	...	...
6430	45	2012-09-28	713173	0	64.88	3.997	192.013558	8.684	September
6431	45	2012-05-10	733455	0	64.89	3.985	192.170412	8.667	May
6432	45	2012-12-10	734464	0	54.47	4.000	192.327265	8.667	December
6433	45	2012-10-19	718125	0	56.47	3.969	192.330854	8.667	October
6434	45	2012-10-26	760281	0	58.85	3.882	192.308899	8.667	October

6435 rows × 9 columns

In [24]:

```
# Generate Month by Number and add to dataset as Exact Month
df['Date'][0].month
df['Exact_month'] = months
df
```

Out[24]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment	Month_name	Exact_month
0	1	2010-05-02	1643690	0	42.31	2.572	211.096358	8.106	May	5
1	1	2010-12-02	1641957	1	38.51	2.548	211.242170	8.106	December	12
2	1	2010-02-19	1611968	0	39.93	2.514	211.289143	8.106	February	2
3	1	2010-02-26	1409727	0	46.63	2.561	211.319643	8.106	February	2
4	1	2010-05-03	1554806	0	46.50	2.625	211.350143	8.106	May	5
...	...	...	...	...	...	...	...	...	...	...
6430	45	2012-09-28	713173	0	64.88	3.997	192.013558	8.684	September	9
6431	45	2012-05-10	733455	0	64.89	3.985	192.170412	8.667	May	5
6432	45	2012-12-10	734464	0	54.47	4.000	192.327265	8.667	December	12
6433	45	2012-10-19	718125	0	56.47	3.969	192.330854	8.667	October	10
6434	45	2012-10-26	760281	0	58.85	3.882	192.308899	8.667	October	10

6435 rows × 10 columns

In [ ]:

In [ ]:

```

```

In [25]:

```
#Get the value count of Holiday Flag
df['Holiday_Flag'].value_counts()
```

Out[25]:

```
0    5985
1     450
Name: Holiday_Flag, dtype: int64
```

In [26]:

```
# Create a variable for Holiday flag with 1
Holiday = df[df['Holiday_Flag'] == 1]
Holiday
```

Out[26]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment	Month_name	Exact_month
1	1	2010-12-02	1641957	1	38.51	2.548	211.242170	8.106	December	12
31	1	2010-10-09	1507460	1	78.69	2.565	211.495190	7.787	October	10
42	1	2010-11-26	1955624	1	64.52	2.735	211.748433	7.838	November	11
47	1	2010-12-31	1367320	1	48.43	2.943	211.404932	7.838	December	12
53	1	2011-11-02	1649614	1	36.39	3.022	212.936705	7.742	November	11
...	...	...	...	...	...	...	...	...	...	...
6375	45	2011-09-09	746129	1	71.48	3.738	186.673738	8.625	September	9
6386	45	2011-11-25	1170672	1	48.71	3.492	188.350400	8.523	November	11
6391	45	2011-12-30	869403	1	37.79	3.389	189.062016	8.523	December	12
6397	45	2012-10-02	803657	1	37.00	3.640	189.707605	8.424	October	10
6427	45	2012-07-09	766512	1	75.70	3.911	191.577676	8.684	July	7

450 rows × 10 columns

In [27]:

```
# Create a variable for Holiday flag with 0
Not_holiday = df[df['Holiday_Flag'] == 0]
Not_holiday
```

Out[27]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment	Month_name	Exact_month
0	1	2010-05-02	1643690	0	42.31	2.572	211.096358	8.106	May	5
2	1	2010-02-19	1611968	0	39.93	2.514	211.289143	8.106	February	2
3	1	2010-02-26	1409727	0	46.63	2.561	211.319643	8.106	February	2
4	1	2010-05-03	1554806	0	46.50	2.625	211.350143	8.106	May	5
5	1	2010-12-03	1439541	0	57.79	2.667	211.380643	8.106	December	12
...	...	...	...	...	...	...	...	...	...	...
6430	45	2012-09-28	713173	0	64.88	3.997	192.013558	8.684	September	9
6431	45	2012-05-10	733455	0	64.89	3.985	192.170412	8.667	May	5
6432	45	2012-12-10	734464	0	54.47	4.000	192.327265	8.667	December	12
6433	45	2012-10-19	718125	0	56.47	3.969	192.330854	8.667	October	10
6434	45	2012-10-26	760281	0	58.85	3.882	192.308899	8.667	October	10

5985 rows × 10 columns

In [28]:

```
# Create a variable for Holiday flag with 1
Holiday_period = df[df['Holiday_Flag'] == 1]
Holiday_period
```

Out[28]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment	Month_name	Exact_month
1	1	2010-12-02	1641957	1	38.51	2.548	211.242170	8.106	December	12
31	1	2010-10-09	1507460	1	78.69	2.565	211.495190	7.787	October	10
42	1	2010-11-26	1955624	1	64.52	2.735	211.748433	7.838	November	11
47	1	2010-12-31	1367320	1	48.43	2.943	211.404932	7.838	December	12
53	1	2011-11-02	1649614	1	36.39	3.022	212.936705	7.742	November	11
...	...	...	...	...	...	...	...	...	...	...
6375	45	2011-09-09	746129	1	71.48	3.738	186.673738	8.625	September	9
6386	45	2011-11-25	1170672	1	48.71	3.492	188.350400	8.523	November	11
6391	45	2011-12-30	869403	1	37.79	3.389	189.062016	8.523	December	12
6397	45	2012-10-02	803657	1	37.00	3.640	189.707605	8.424	October	10
6427	45	2012-07-09	766512	1	75.70	3.911	191.577676	8.684	July	7

450 rows × 10 columns

In [29]:

```
# Create a variable for Holiday flag with 0
Non_holiday = df[df['Holiday_Flag'] == 0]
Non_holiday
```

Out[29]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment	Month_name	Exact_month
0	1	2010-05-02	1643690	0	42.31	2.572	211.096358	8.106	May	5
2	1	2010-02-19	1611968	0	39.93	2.514	211.289143	8.106	February	2
3	1	2010-02-26	1409727	0	46.63	2.561	211.319643	8.106	February	2
4	1	2010-05-03	1554806	0	46.50	2.625	211.350143	8.106	May	5
5	1	2010-12-03	1439541	0	57.79	2.667	211.380643	8.106	December	12
...	...	...	...	...	...	...	...	...	...	...
6430	45	2012-09-28	713173	0	64.88	3.997	192.013558	8.684	September	9
6431	45	2012-05-10	733455	0	64.89	3.985	192.170412	8.667	May	5
6432	45	2012-12-10	734464	0	54.47	4.000	192.327265	8.667	December	12
6433	45	2012-10-19	718125	0	56.47	3.969	192.330854	8.667	October	10
6434	45	2012-10-26	760281	0	58.85	3.882	192.308899	8.667	October	10

5985 rows × 10 columns

In [30]:

```
# Create a variable for grouped Holiday by Month and weeklySales
Hol_by_month = Holiday_period.groupby('Month_name')['Weekly_Sales'].mean()
Hol_by_month
```

Out[30]:

```
Month_name
December     9.986044e+05
July         1.074001e+06
November     1.331487e+06
October      1.062708e+06
September    1.039182e+06
Name: Weekly_Sales, dtype: float64
```

In [31]:

```
# Create a variable for grouped Non Holiday by WeeklySales
Non_hol_by_month = Not_holiday['Weekly_Sales'].mean()
Non_hol_by_month
```

Out[31]:

```
1041255.8887218045
```

In [32]:

```
#Create a Bolean expression comparing Holiday and non Holiday
Hol_by_month > Non_hol_by_month
```

Out[32]:

```
Month_name
December     False
July          True
November      True
October       True
September    False
Name: Weekly_Sales, dtype: bool
```

In [33]:

```
#Holiday with Higher Sales
Hol_with_higher_sales = np.round(Hol_by_month[(Hol_by_month) > (Non_hol_by_month)], 0)
Hol_with_higher_sales
```

Out[33]:

```
Month_name
July        1074001.0
November    1331487.0
October     1062708.0
Name: Weekly_Sales, dtype: float64
```

In [34]:

```
#Convert to dataframe
Hol_with_higher_sales = pd.DataFrame(Hol_with_higher_sales)
Hol_with_higher_sales.reset_index()
```

Out[34]:

	Month_name	Weekly_Sales
0	July	1074001.0
1	November	1331487.0
2	October	1062708.0

Answer 4 : February (Super Bowl), September (Labour Day) and November (Thanksgiving Day) all have sales that is higher than the mean of all sales in non-holiday season for all stores together

Provide a monthly and semester view of sales in units and give insights

In [35]:

```
#Convert to datetime
pd.to_datetime(df["Date"])
```

Out[35]:

```
0      2010-05-02
1      2010-12-02
2      2010-02-19
3      2010-02-26
4      2010-05-03
          ...
6430   2012-09-28
6431   2012-05-10
6432   2012-12-10
6433   2012-10-19
6434   2012-10-26
Name: Date, Length: 6435, dtype: datetime64[ns]
```

In [36]:

```
#View the dataset
df
```

Out[36]:

Out[36]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment	Month_name	Exact_month
0	1	2010-05-02	1643690	0	42.31	2.572	211.096358	8.106	May	5
1	1	2010-12-02	1641957	1	38.51	2.548	211.242170	8.106	December	12
2	1	2010-02-19	1611968	0	39.93	2.514	211.289143	8.106	February	2
3	1	2010-02-26	1409727	0	46.63	2.561	211.319643	8.106	February	2
4	1	2010-05-03	1554806	0	46.50	2.625	211.350143	8.106	May	5
...	...	...	...	...	...	...	...	...	...	...
6430	45	2012-09-28	713173	0	64.88	3.997	192.013558	8.684	September	9
6431	45	2012-05-10	733455	0	64.89	3.985	192.170412	8.667	May	5
6432	45	2012-12-10	734464	0	54.47	4.000	192.327265	8.667	December	12
6433	45	2012-10-19	718125	0	56.47	3.969	192.330854	8.667	October	10
6434	45	2012-10-26	760281	0	58.85	3.882	192.308899	8.667	October	10

6435 rows × 10 columns

In [37]:

```
#Create a Variable with Exact Month Month Name and Weekly Sales
Monthly_sales = df[['Exact_month','Month_name','Weekly_Sales']]
Monthly_sales
```

Out[37]:

	Exact_month	Month_name	Weekly_Sales
0	5	May	1643690
1	12	December	1641957
2	2	February	1611968
3	2	February	1409727
4	5	May	1554806
...	...	...	...
6430	9	September	713173
6431	5	May	733455
6432	12	December	734464
6433	10	October	718125
6434	10	October	760281

6435 rows × 3 columns

In [38]:

```
#Get Exact Month
Monthly_sales['Exact_month']
```

Out[38]:

```
0        5
1       12
2        2
3        2
4        5
        ..
6430     9
6431     5
6432    12
6433    10
6434    10
Name: Exact_month, Length: 6435, dtype: int64
```

In [39]:

```
# Round up and sum up Exact Month and Month Name by Weekly Sales
Monthly_sales = np.round(Monthly_sales.groupby(['Exact_month','Month_name'])['Weekly_Sales'].sum(),0)
Monthly_sales
```

Out[39]:

Out[39]:

```
Exact_month  Month_name
1            January      426426052
2            February     522025442
3            March        553486149
4            April        645323579
5            May          605696302
6            June         575017693
7            July         593313647
8            August       564231431
9            September    590531965
10           October      602918574
11           November     459169138
12           December     599075852
Name: Weekly_Sales, dtype: int64
```

In [40]:

```
#Convert to dataframe
Monthly_sales = pd.DataFrame(Monthly_sales)
Monthly_sales
```

Out[40]:

		Weekly_Sales
Exact_month	**Month_name**	
1	January	426426052
2	February	522025442
3	March	553486149
4	April	645323579
5	May	605696302
6	June	575017693
7	July	593313647
8	August	564231431
9	September	590531965
10	October	602918574
11	November	459169138
12	December	599075852

In [41]:

```
Monthly_sales.reset_index(inplace=True)
Monthly_sales
```

Out[41]:

	Exact_month	Month_name	Weekly_Sales
0	1	January	426426052
1	2	February	522025442
2	3	March	553486149
3	4	April	645323579
4	5	May	605696302
5	6	June	575017693
6	7	July	593313647
7	8	August	564231431
8	9	September	590531965
9	10	October	602918574
10	11	November	459169138
11	12	December	599075852

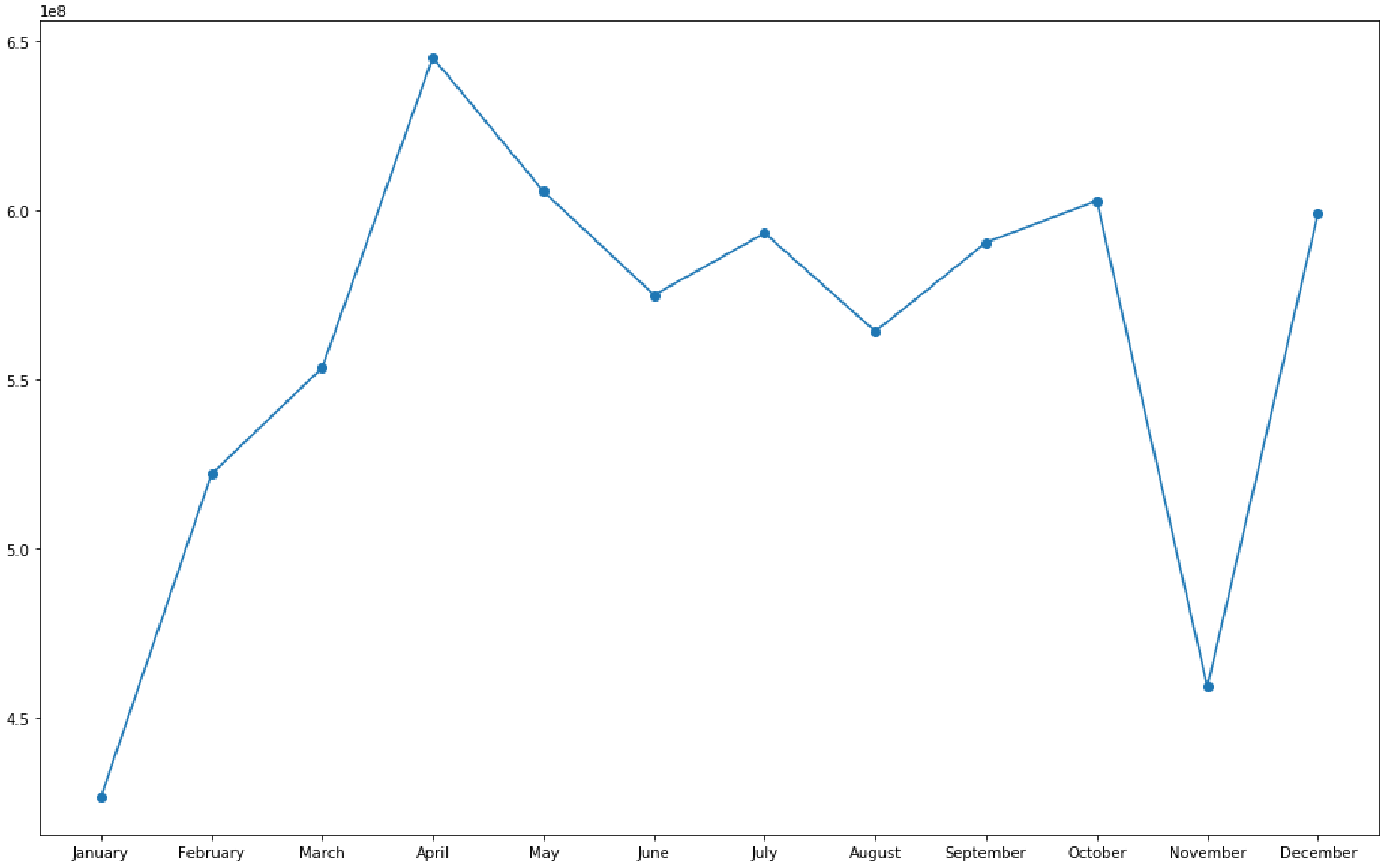
In [42]:

```
#Create a plot a graph of Weekly sales and Monthly Name  from Monthly Sales variable
```

```
plt.figure(figsize=[16,10])
plt.plot('Month_name','Weekly_Sales', data = Monthly_sales, marker='o')
```

Out[42]:

```
[<matplotlib.lines.Line2D at 0x21620383c88>]
```



Answer: According to the graph above there was greatest increase in sell was from January to february followed by November to December¶

In [ ]:

```

```

In [ ]:

```

```

STATISTICAL ANALYSIS

Linear Regression – Utilize variables like date and restructure dates as 1 for 5 Feb 2010 (starting from the earliest date in order). Hypothesize if CPI, unemployment, and fuel price have any impact on sales.

In [ ]:

```

```

In [43]:

```
#Create a Variable by selecting only data with STORE 1
stat= df[df['Store'] == 1]
stat
```

Out[43]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment	Month_name	Exact_month

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment	Month_name	Exact_month
0	1	2010-05-02	1643690	0	42.31	2.572	211.096358	8.106	May	5
1	1	2010-12-02	1641957	1	38.51	2.548	211.242170	8.106	December	12
2	1	2010-02-19	1611968	0	39.93	2.514	211.289143	8.106	February	2
3	1	2010-02-26	1409727	0	46.63	2.561	211.319643	8.106	February	2
4	1	2010-05-03	1554806	0	46.50	2.625	211.350143	8.106	May	5
...	...	...	...	...	...	...	...	...	...	...
138	1	2012-09-28	1437059	0	76.08	3.666	222.981658	6.908	September	9
139	1	2012-05-10	1670785	0	68.55	3.617	223.181477	6.573	May	5
140	1	2012-12-10	1573072	0	62.99	3.601	223.381296	6.573	December	12
141	1	2012-10-19	1508068	0	67.97	3.594	223.425723	6.573	October	10
142	1	2012-10-26	1493659	0	69.16	3.506	223.444251	6.573	October	10

143 rows × 10 columns

In [44]:

```
#Create a variable from the eariler data set of Store and Date
Stad = stat[['Store','Date']]
pd.DataFrame(Stad)
```

Out[44]:

	Store	Date
0	1	2010-05-02
1	1	2010-12-02
2	1	2010-02-19
3	1	2010-02-26
4	1	2010-05-03
...	...	...
138	1	2012-09-28
139	1	2012-05-10
140	1	2012-12-10
141	1	2012-10-19
142	1	2012-10-26

143 rows × 2 columns

In [ ]:

```

```

In [ ]:

```

```

In [45]:

```
#Assign Numbers to the Date
date_obj = stat[['Date']]
date_obj.index +=1
Stad.Date = date_obj.index
Stad
```

```
C:\Users\cugagu\AppData\Local\Continuum\anaconda3\lib\site-packages\pandas\core\generic.py:5208: SettingWi
thCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html
#returning-a-view-versus-a-copy
  self[name] = value
```

Out[45]:

	Store	Date

0	Store	Date
1	1	2
2	1	3
3	1	4
4	1	5
...	...	...
138	1	139
139	1	140
140	1	141
141	1	142
142	1	143

143 rows × 2 columns

Linear Regression Answer 1

In [ ]:

```

```

In [46]:

```
#Generate the original dataset
df
```

Out[46]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment	Month_name	Exact_month
0	1	2010-05-02	1643690	0	42.31	2.572	211.096358	8.106	May	5
1	1	2010-12-02	1641957	1	38.51	2.548	211.242170	8.106	December	12
2	1	2010-02-19	1611968	0	39.93	2.514	211.289143	8.106	February	2
3	1	2010-02-26	1409727	0	46.63	2.561	211.319643	8.106	February	2
4	1	2010-05-03	1554806	0	46.50	2.625	211.350143	8.106	May	5
...	...	...	...	...	...	...	...	...	...	...
6430	45	2012-09-28	713173	0	64.88	3.997	192.013558	8.684	September	9
6431	45	2012-05-10	733455	0	64.89	3.985	192.170412	8.667	May	5
6432	45	2012-12-10	734464	0	54.47	4.000	192.327265	8.667	December	12
6433	45	2012-10-19	718125	0	56.47	3.969	192.330854	8.667	October	10
6434	45	2012-10-26	760281	0	58.85	3.882	192.308899	8.667	October	10

6435 rows × 10 columns

In [47]:

```
#Create a variable with Fuel price ,CPI ,Unemployment ,Weekly Sales  from the Variable with only store 1
dat = stat[['Fuel_Price','CPI','Unemployment','Weekly_Sales',]]
dat
```

Out[47]:

	Fuel_Price	CPI	Unemployment	Weekly_Sales
0	2.572	211.096358	8.106	1643690
1	2.548	211.242170	8.106	1641957
2	2.514	211.289143	8.106	1611968
3	2.561	211.319643	8.106	1409727
4	2.625	211.350143	8.106	1554806
...	...	...	...	...
138	3.666	222.981658	6.908	1437059
139	3.617	223.181477	6.573	1670785

	Fuel_Price	CPI	Unemployment	Weekly_Sales
140	3.601	223.381296	6.573	1578072
141	3.594	223.425723	6.573	1508068
142	3.506	223.444251	6.573	1493659

143 rows × 4 columns

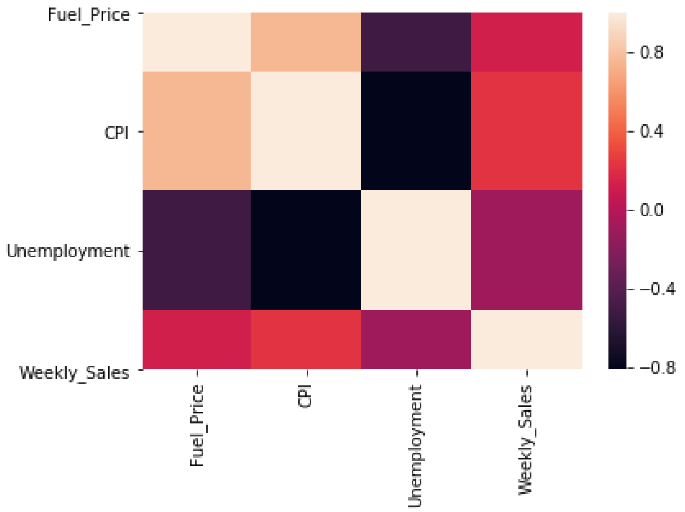
In [ ]:

In [48]:

```
#Heatmap of the variable
sns.heatmap(dat.corr())
```

Out[48]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x216207eae48>
```



In [ ]:

In [49]:

```
#Create Dependent variable (y) and independent variable (x)
x=dat.drop('Weekly_Sales',axis=1)
y=dat['Weekly_Sales']
```

In [ ]:

In [50]:

```
#Create a test and train from dependent and independed variable
x_train, x_test, y_train, y_test = train_test_split(x ,y,test_size = 0.2 ,random_state =1 )
```

In [51]:

```
#Create a linear Regression and fit x train and x test
model=LinearRegression()
model.fit(x_train,y_train)
```

Out[51]:

```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None, normalize=False)
```

In [55]:

In [53]:

```
#append values to the array
x = np.append (arr=np.ones((143 , 1)) .astype(int), values=x,axis=1)
```

In [54]:

```
#backward elimination method
#Create the array according the number of column on data set and get the OLS and fit the generate summary
x_opt = np.array(x[:, [0, 1, 2, 3]], dtype=float)
model_ols =sm.OLS(endog = y ,exog = x_opt).fit()
model_ols.summary()
```

Out[54]:

OLS Regression Results

Dep. Variable:	Weekly_Sales	**R-squared:**	0.085
Model:	OLS	**Adj. R-squared:**	0.065
Method:	Least Squares	**F-statistic:**	4.303
Date:	Mon, 29 Jun 2020	**Prob (F-statistic):**	0.00616
Time:	10:01:09	**Log-Likelihood:**	-1906.0
No. Observations:	143	**AIC:**	3820.
Df Residuals:	139	**BIC:**	3832.
Df Model:	3		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	-3.887e+06	1.74e+06	-2.234	0.027	-7.33e+06	-4.46e+05
x1	-6.484e+04	4.68e+04	-1.384	0.169	-1.57e+05	2.78e+04
x2	2.179e+04	6785.272	3.212	0.002	8375.997	3.52e+04
x3	1.241e+05	5.88e+04	2.111	0.037	7846.314	2.4e+05

Omnibus:	93.038	**Durbin-Watson:**	1.544
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	655.591
Skew:	2.267	**Prob(JB):**	4.37e-143
Kurtosis:	12.459	**Cond. No.**	2.99e+04

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 2.99e+04. This might indicate that there are
strong multicollinearity or other numerical problems.

In [ ]:

```
#If P values is greater than significant Level which is 0.05 the eliminate the array till you get the a P value less than 0.05
```

In [ ]:

```

```

In [151]:

```
#Second Elimination
x_opt = np.array(x[:, [0, 2,3]], dtype=float)
model_ols =sm.OLS(endog = y ,exog = x_opt).fit()
model_ols.summary()
```

Out[151]:

OLS Regression Results

Dep. Variable:	Weekly_Sales	**R-squared:**	0.072
Model:	OLS	**Adj. R-squared:**	0.059
Method:	Least Squares	**F-statistic:**	5.461
Date:	Sun, 28 Jun 2020	**Prob (F-statistic):**	0.00520
Time:	19:03:15	**Log-Likelihood:**	-1907.0
No. Observations:	143	**AIC:**	3820.
Df Residuals:	140	**BIC:**	3829.

Df Model:	2
Covariance Type:	nonrobust

	coef	std err	t	P>|t|	[0.025	0.975]
const	-2.562e+06	1.46e+06	-1.757	0.081	-5.44e+06	3.21e+05
x1	1.544e+04	5017.492	3.078	0.003	5524.333	2.54e+04
x2	1.026e+05	5.69e+04	1.804	0.073	-9843.409	2.15e+05

Omnibus:	95.127	**Durbin-Watson:**	1.522
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	675.235
Skew:	2.333	**Prob(JB):**	2.37e-147
Kurtosis:	12.568	**Cond. No.**	2.49e+04

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 2.49e+04. This might indicate that there are
strong multicollinearity or other numerical problems.

In [ ]:

```
```

In [152]:

```
#Third Elimination
x_opt = np.array(x[:, [2,3]], dtype=float)
model_ols =sm.OLS(endog = y ,exog = x_opt).fit()
model_ols.summary()
```

Out[152]:

OLS Regression Results

Dep. Variable:	Weekly_Sales	**R-squared (uncentered):**	0.991
Model:	OLS	**Adj. R-squared (uncentered):**	0.990
Method:	Least Squares	**F-statistic:**	7449.
Date:	Sun, 28 Jun 2020	**Prob (F-statistic):**	1.06e-143
Time:	19:03:15	**Log-Likelihood:**	-1908.5
No. Observations:	143	**AIC:**	3821.
Df Residuals:	141	**BIC:**	3827.
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
x1	6760.8828	874.077	7.735	0.000	5032.892	8488.873
x2	1.25e+04	2.48e+04	0.504	0.615	-3.65e+04	6.15e+04

Omnibus:	95.640	**Durbin-Watson:**	1.472
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	648.694
Skew:	2.375	**Prob(JB):**	1.37e-141
Kurtosis:	12.291	**Cond. No.**	421.

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

In [ ]:

```
```

In [153]:

```
#Last elimination
x_opt = np.array(x[:, [2]], dtype=float)
model_ols =sm.OLS(endog = y ,exog = x_opt).fit()
model_ols.summary()
```

Out[153]:

OLS Regression Results

Dep. Variable:	Weekly_Sales	**R-squared (uncentered):**	0.991
Model:	OLS	**Adj. R-squared (uncentered):**	0.991
Method:	Least Squares	**F-statistic:**	1.498e+04
Date:	Sun, 28 Jun 2020	**Prob (F-statistic):**	7.87e-146
Time:	19:03:16	**Log-Likelihood:**	-1908.6
No. Observations:	143	**AIC:**	3819.
Df Residuals:	142	**BIC:**	3822.
Df Model:	1		
Covariance Type:	nonrobust		

	coef	**std err**	**t**	**P>|t|**	**[0.025**	**0.975]**
x1	7200.7540	58.841	122.376	0.000	7084.436	7317.072

Omnibus:	96.801	**Durbin-Watson:**	1.467
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	671.494
Skew:	2.402	**Prob(JB):**	1.54e-146
Kurtosis:	12.467	**Cond. No.**	1.00

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

In [154]:

```
#Get the first 5 values of the final array whose p values is less than 0.05
x_opt[: 5]
```

Out[154]:

```
array([[211.0963582],
       [211.2421698],
       [211.2891429],
       [211.3196429],
       [211.3501429]])
```

In [155]:

```
#Get the First 5 dataset of the DAT data frame and match with  x_opt array
dat.head()
```

Out[155]:

	Fuel_Price	**CPI**	**Unemployment**	**Weekly_Sales**
0	2.572	211.096358	8.106	1643690
1	2.548	211.242170	8.106	1641957
2	2.514	211.289143	8.106	1611968
3	2.561	211.319643	8.106	1409727
4	2.625	211.350143	8.106	1554806

Linear Regression Answer 2: CPI has impact on Weekly Sales

In [ ]:

```

```

Change dates into days by creating new variable.

In [156]:

```
#Creat a DAY column and generate day name
df['Day'] = pd.to_datetime(df['Date']).dt.day_name()
df.head()
```

Out[156]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment	Month_name	Exact_month	Day
0	1	2010-05-02	1643690	0	42.31	2.572	211.096358	8.106	May	5	Sunday
1	1	2010-12-02	1641957	1	38.51	2.548	211.242170	8.106	December	12	Thursday
2	1	2010-02-19	1611968	0	39.93	2.514	211.289143	8.106	February	2	Friday
3	1	2010-02-26	1409727	0	46.63	2.561	211.319643	8.106	February	2	Friday
4	1	2010-05-03	1554806	0	46.50	2.625	211.350143	8.106	May	5	Monday

In [ ]:

In [ ]: