Retail Analysis with Walmart Data

Analysis Tasks

1. Basic Statistics tasks
2. 1 Which store has maximum sales
3. 2 Which store has maximum standard deviation i.e., the sales vary a lot. Also, find out the coefficient of mean to standard deviation
4. 3 Which store/s has good quarterly growth rate in Q3'2012
5. 4 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
6. 5 Provide a monthly and semester view of sales in units and give insights
7. Statistical Model

For Store 1 – Build prediction models to forecast demand

2. 1 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.
3. 2 Change dates into days by creating new variable.

In [117]:
```
# Import libraries

import pandas as pd
import seaborn as sns
import numpy as np
import matplotlib.pyplot as plt
from matplotlib import dates
from datetime import datetime
```

In [6]:
```
# Load dataset
data = pd.read_csv('D:\\walmart_store_sales\\Walmart_Store_sales.csv')
data.head()
```

Out[6]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment
0	1	05-02-2010	1643690.90	0	42.31	2.572	211.096358	8.106
1	1	12-02-2010	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	05-03-2010	1554806.68	0	46.50	2.625	211.350143	8.106

In [3]:
```
# check shape of data
data.shape
```

Out[3]:
```
(6435, 8)
```

In [7]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6435 entries, 0 to 6434
Data columns (total 8 columns):
 #   Column        Non-Null Count  Dtype  
---  ------        --------------  -----  
 0   Store         6435 non-null   int64  
 1   Date          6435 non-null   object 
 2   Weekly_Sales  6435 non-null   float64
 3   Holiday_Flag  6435 non-null   int64  
 4   Temperature   6435 non-null   float64
 5   Fuel_Price    6435 non-null   float64
 6   CPI           6435 non-null   float64
 7   Unemployment  6435 non-null   float64
dtypes: float64(5), int64(2), object(1)
memory usage: 402.3+ KB
```

In [8]:
```
da
```

Out[8]:
```
Index(['Store', 'Date', 'Weekly_Sales', 'Holiday_Flag', 'Temperature',
       'Fuel_Price', 'CPI', 'Unemployment'],
      dtype='object')
```

In [9]:
```
data.Store.unique()
```

Out[9]:
```
array([ 1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16, 17,
       18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34,
       35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45], dtype=int64)
```

1. 1 Which store has maximum sales

In [10]:
```
sales_list=[]
sales_list=data.groupby(['Store'])['Weekly_Sales'].sum()
max_sales=max(data.groupby(['Store'])['Weekly_Sales'].sum())
sales_list
```

Out[10]:
```
Store
1     2.224028e+08
2     2.753824e+08
3     5.758674e+07
4     2.995440e+08
5     4.547569e+07
6     2.237561e+08
7     8.159828e+07
8     1.299512e+08
9     7.778922e+07
10    2.716177e+08
11    1.939628e+08
12    1.442872e+08
13    2.865177e+08
14    2.889999e+08
15    8.913368e+07
16    7.425243e+07
17    1.277821e+08
18    1.551147e+08
19    2.066349e+08
20    3.013978e+08
21    1.081179e+08
22    1.470756e+08
23    1.987506e+08
24    1.940160e+08
25    1.010612e+08
26    1.434164e+08
27    2.538559e+08
28    1.892637e+08
29    7.714155e+07
30    6.271689e+07
31    1.996139e+08
32    1.668192e+08
33    3.716022e+07
34    1.382498e+08
35    1.315207e+08
36    5.341221e+07
37    7.420274e+07
38    5.515963e+07
39    2.074455e+08
40    1.378703e+08
41    1.813419e+08
42    7.956575e+07
43    9.056544e+07
44    4.329309e+07
45    1.123953e+08
Name: Weekly_Sales, dtype: float64
```

In [11]:
```
for i in range(1,46):
    if max_sales==sales_list[i]:
        print("Store which has maximum sales of {} is {}".format(max_sales,i))
```

```
Store which has maximum sales of 301397792.46 is 20
```

```
# Conclusion
Store 20 has maximum sales of 301397792.46
```

1. 2 Which store has maximum standard deviation

In [14]:
```
std_dev=[]
std_dev=data.groupby(['Store'])['Weekly_Sales'].std()
max_std=max(data.groupby(['Store'])['Weekly_Sales'].std())
print(std_dev)
```

```
Store
1     155980.767761
2     237683.694682
3      46319.631557
4     266201.442297
5      37737.965745
6     212525.855862
7     112585.469220
8     106280.829881
9      69028.666585
10    302262.062504
11    165833.887863
12    139166.871880
13    265506.995776
14    317569.949476
15    120538.652043
16     85769.680133
17    112162.936087
18    176641.510839
19    191722.638730
20    275900.562742
21    128752.812853
22    161251.350631
23    249788.038068
24    167745.677567
25    112976.788600
26    110431.288141
27    239930.135688
28    181758.967539
29     99120.136596
30     22809.665590
31    125855.942933
32    138017.252087
33     24132.927322
34    104630.164676
35    211243.457791
36     60725.173579
37     21837.461190
38     42768.169450
39    217466.454833
40    119002.112858
41    187907.162766
42     50262.925530
43     40598.413260
44     24762.832015
45    130168.526635
Name: Weekly_Sales, dtype: float64
```

In [ ]:
```

```

In [15]:
```
for i in range(1,46):
    if max_std==std_dev[i]:
        print('Store which has maximum standard deviation of {} is {}'.format(max_std,i))
```

```
Store which has maximum standard deviation of 317569.9494755081 is 14
```

Store 14 has maximum standard deviation of 317569.9494755081

1. 3 Which store/s has good quarterly growth rate in Q3'2012

In [32]:
```
data_safe=data
```

In [33]:
```
data["Date"]=pd.to_datetime(data["Date"])
```

In [35]:
```
#Third Quartile Period

date_from=pd.Timestamp(date(2012,7,1))
date_to = pd.Timestamp(date(2012,9,1))
```

In [36]:
```
data_safe = data_safe[
    (data_safe['Date'] > date_from ) &
    (data_safe['Date'] < date_to)]
```

In [37]:
```
data_safe
```

Out[37]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment	Day	Month	Year
122	1	2012-08-06	1697230.96	0	78.30	3.452	221.749484	7.143	6	8	2012
127	1	2012-07-13	1527014.04	0	77.12	3.256	221.924158	6.908	13	7	2012
128	1	2012-07-20	1497954.76	0	80.42	3.311	221.932727	6.908	20	7	2012
129	1	2012-07-27	1439123.71	0	82.66	3.407	221.941295	6.908	27	7	2012
132	1	2012-08-17	1597868.05	0	84.85	3.571	222.038411	6.908	17	8	2012
...	...	...	...	...	...	...	...	...	...	...	...
6421	45	2012-07-27	711671.58	0	77.20	3.647	191.165566	8.684	27	7	2012
6424	45	2012-08-17	722496.93	0	75.71	3.807	191.228492	8.684	17	8	2012
6425	45	2012-08-24	718232.26	0	72.62	3.834	191.344887	8.684	24	8	2012
6426	45	2012-08-31	734297.87	0	75.09	3.867	191.461281	8.684	31	8	2012
6427	45	2012-07-09	766512.66	1	75.70	3.911	191.577676	8.684	9	7	2012

360 rows × 11 columns

In [40]:
```
Q3_growth=[]
Q3_growth=data_safe.groupby(['Store'])['Weekly_Sales'].sum()
max_Q3_growth=max(data_safe.groupby(['Store'])['Weekly_Sales'].sum())
print(Q3_growth)
print(max_Q3_growth)
```

```
Store
1     12497164.63
2     15068546.49
3      3309539.61
4     17184755.18
5      2616077.17
6     12602014.74
7      5145719.21
8      7287654.54
9      4379738.32
10    14244984.38
11    10859741.55
12     7975256.52
13    16547587.90
14    13476932.21
15     4749680.33
16     4439284.00
17     7691713.66
18     8487908.30
19    11238000.13
20    16441784.91
21     5705679.85
22     8011276.00
23    11874225.21
24    11036817.80
25     5660441.24
26     8477063.95
27    13966116.82
28     9985386.04
29     4169231.08
30     3428281.56
31    11035442.71
32     9545018.65
33     2116785.52
34     7672976.76
35     7047799.89
36     2393072.59
37     4150660.97
38     3437491.66
39    12930297.16
40     7972353.84
41    11238592.05
42     4551141.89
43     4935069.08
44     2677995.56
45     5935775.03
Name: Weekly_Sales, dtype: float64
17184755.18
```

In [56]:
```
max_Q3_growth
```

Out[56]:
```
17184755.18
```

```
# Conclusion

Store 14 has maximum Q3 growth of 17184755.18
```

1. 4 Some holidays have a negative impact on sales.

In [58]:
```
Christmas_sales=data.loc[(data["Date"]=="2010-12-31") | (data["Date"]=="2011-12-31") | (data["Date"]=
Christmas_sales.head()
```

Out[58]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment	Day	Month	Year
47	1	2010-12-31	1367320.01	1	48.43	2.943	211.404932	7.838	31	12	2010
190	2	2010-12-31	1750434.55	1	47.30	2.943	211.064774	8.163	31	12	2010
333	3	2010-12-31	382677.76	1	53.20	2.943	214.698647	7.564	31	12	2010
476	4	2010-12-31	1794868.74	1	38.09	2.955	127.087677	7.127	31	12	2010
619	5	2010-12-31	298180.18	1	49.79	2.943	211.956714	6.768	31	12	2010

In [57]:
```
Christmas_sales["Weekly_Sales"].sum()
```

Out[57]:
```
40432519.0
```

In [61]:
```
Labour_Day=data.loc[(data["Date"]=="2010-09-10") | (data["Date"]=="2011-09-09") | (data["Date"]=="201
Labour_Day.head()
```

Out[61]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment	Day	Month	Year
83	1	2011-09-09	1540471.24	1	76.00	3.546	215.861056	7.962	9	9	2011
226	2	2011-09-09	1748000.65	1	77.97	3.546	215.514829	7.852	9	9	2011
369	3	2011-09-09	377347.49	1	81.72	3.546	219.213530	7.567	9	9	2011
512	4	2011-09-09	2093139.01	1	73.34	3.554	129.368613	5.644	9	9	2011
655	5	2011-09-09	321110.22	1	79.04	3.546	216.422682	6.529	9	9	2011

In [63]:
```
Labour_Day["Weekly_Sales"].sum()
```

Out[63]:
```
46763227.529999994
```

In [65]:
```
Thanksgivings=data.loc[(data["Date"]=="2010-11-26") | (data["Date"]=="2011-11-25") | (data["Date"]=="
Thanksgivings.head()
```

Out[65]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment	Day	Month	Year
42	1	2010-11-26	1955624.11	1	64.52	2.735	211.748433	7.838	26	11	2010
94	1	2011-11-25	2033320.66	1	60.14	3.236	218.467621	7.866	25	11	2011
185	2	2010-11-26	2658725.29	1	62.98	2.735	211.406287	8.163	26	11	2010
237	2	2011-11-25	2614202.30	1	56.36	3.236	218.113027	7.441	25	11	2011
328	3	2010-11-26	565567.84	1	68.71	2.735	215.061403	7.564	26	11	2010

In [66]:
```
Thanksgivings["Weekly_Sales"].sum()
```

Out[66]:
```
132414608.5
```

Conclusion

1. Holidays which have higher sales is Thanksgivings
2. Total weekly sales of thanksgiving holidays is 132414608.5
3. Total sales in Labour day is 46763227.5

4. Total sales in christmas holidays is 40432519.0

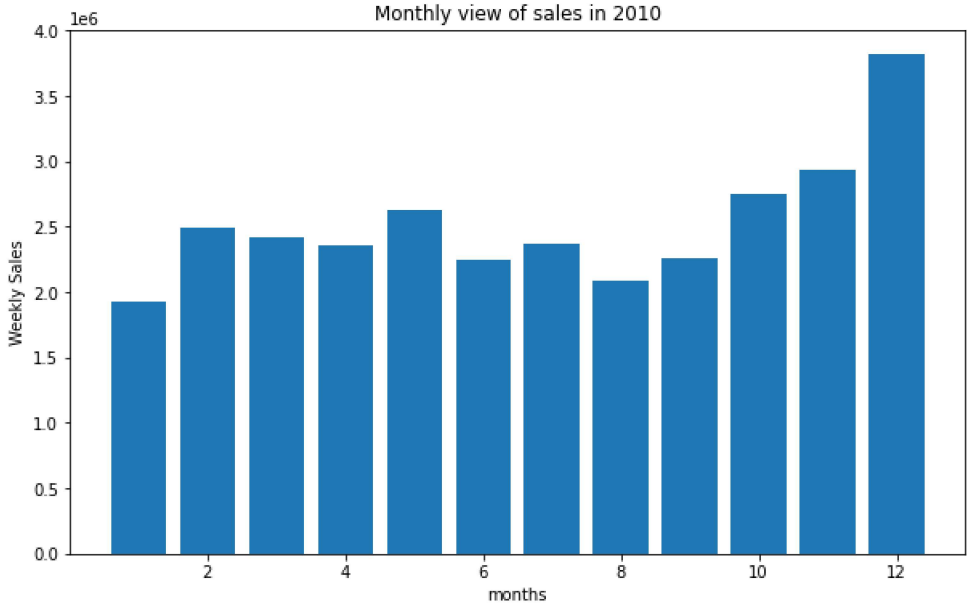
1. 5 Provide a monthly and semester view of sales in units and give insights

In [68]:
```
data["Year"]= pd.DatetimeIndex(data['Date']).year
data["Month"]= pd.DatetimeIndex(data['Date']).month
```

In [71]:
```
year_2010=data.loc[data["Year"]==2010]
year_2011=data.loc[data["Year"]==2011]
year_2012=data.loc[data["Year"]==2012]
```

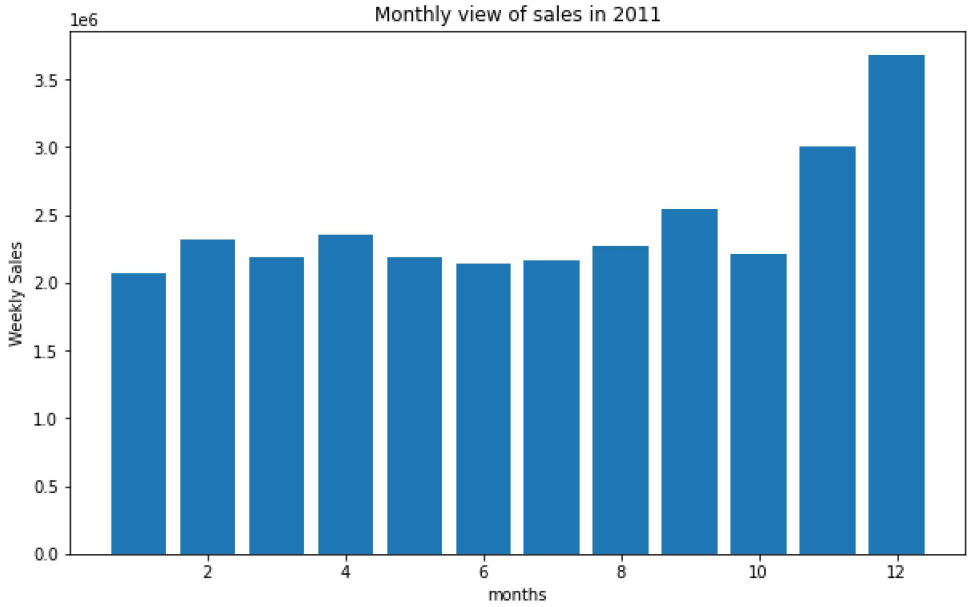
In [76]:
```
# Monthly view of sales in 2010

plt.figure(figsize=(10,6))
plt.bar(year_2010["Month"],year_2010["Weekly_Sales"])
plt.xlabel("months")
plt.ylabel("Weekly Sales")
plt.title("Monthly view of sales in 2010")
```

Out[76]: Text(0.5, 1.0, 'Monthly view of sales in 2010')



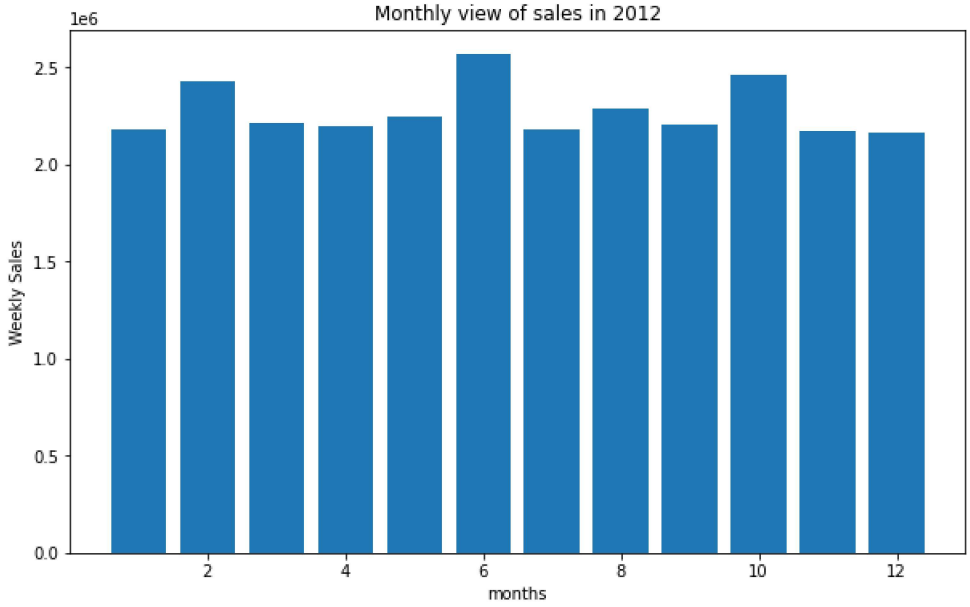
In [77]:
```
# Monthly view of sales in 2011
plt.figure(figsize=(10,6))
plt.bar(year_2011["Month"],year_2011["Weekly_Sales"])
plt.xlabel("months")
plt.ylabel("Weekly Sales")
plt.title("Monthly view of sales in 2011")
```

Out[77]:
```
Text(0.5, 1.0, 'Monthly view of sales in 2011')
```



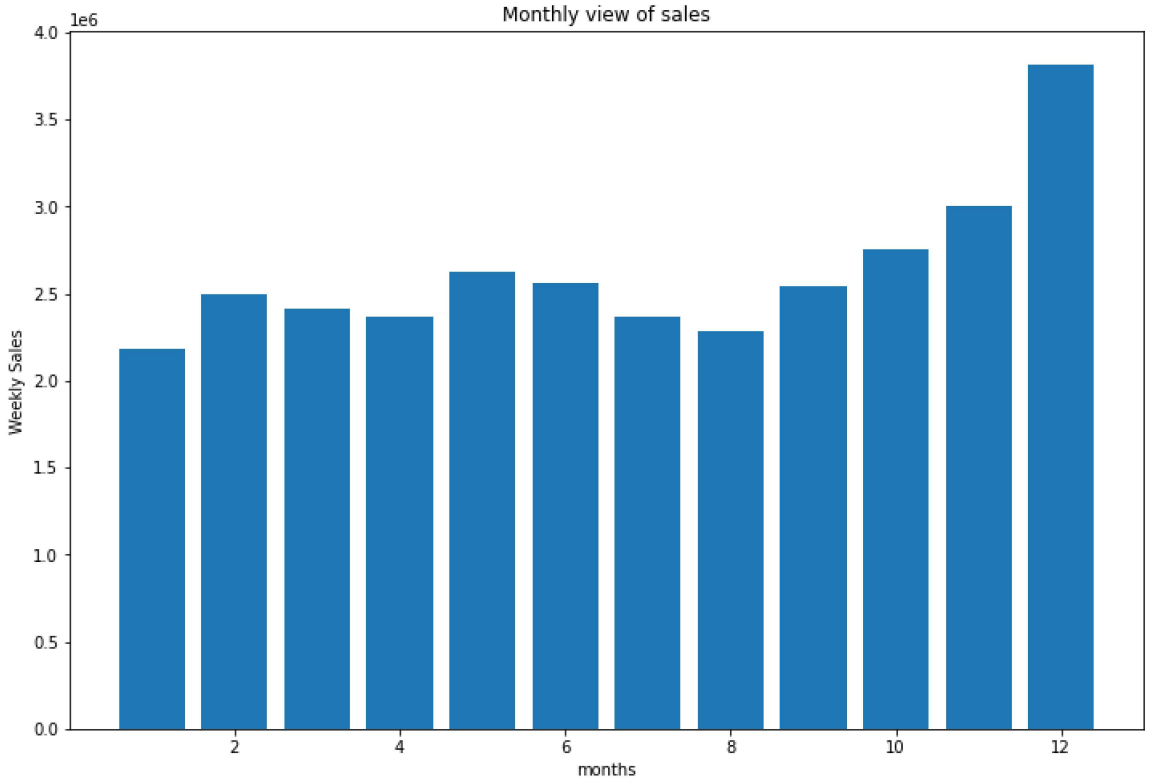
In [78]:
```
# Monthly view of sales in 2012

plt.figure(figsize=(10,6))
plt.bar(year_2012["Month"],year_2012["Weekly_Sales"])
plt.xlabel("months")
plt.ylabel("Weekly Sales")
plt.title("Monthly view of sales in 2012")
```

Out[78]:
```
Text(0.5, 1.0, 'Monthly view of sales in 2012')
```



In [82]:
```
# All months view of sales

plt.figure(figsize=(12,8))
plt.bar(data["Month"],data["Weekly_Sales"])
plt.xlabel("months")
plt.ylabel("Weekly Sales")
plt.title("Monthly view of sales")
```

Out[82]: Text(0.5, 1.0, 'Monthly view of sales')

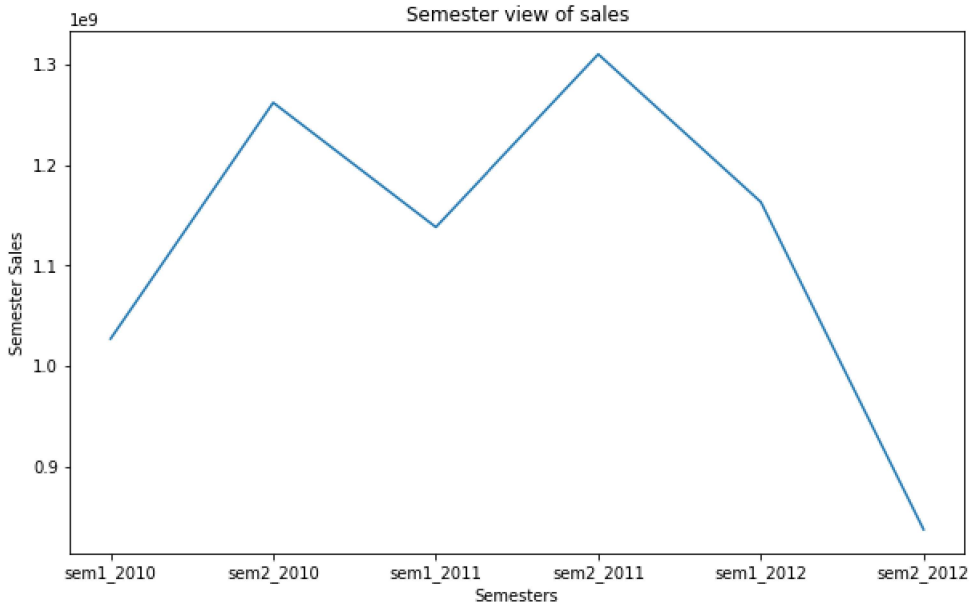


In [83]:
```
# Semesterwise sale
semester_sales=[]
semester_sales.append(year_2010.loc[year_2010["Month"]<7,["Weekly_Sales"]].sum())
semester_sales.append(year_2010.loc[year_2010["Month"]>6,["Weekly_Sales"]].sum())
semester_sales.append(year_2011.loc[year_2011["Month"]<7,["Weekly_Sales"]].sum())
semester_sales.append(year_2011.loc[year_2011["Month"]>6,["Weekly_Sales"]].sum())
semester_sales.append(year_2012.loc[year_2012["Month"]<7,["Weekly_Sales"]].sum())
semester_sales.append(year_2012.loc[year_2012["Month"]>6,["Weekly_Sales"]].sum())
```

In [84]:
```
semester_names=["sem1_2010","sem2_2010","sem1_2011","sem2_2011","sem1_2012","sem2_2012"]
```

In [85]:
```
plt.figure(figsize=(10,6))
plt.plot(semester_names,semester_sales)
plt.xlabel("Semesters")
plt.ylabel("Semester Sales")
plt.title("Semester view of sales")
```

Out[85]:
```
Text(0.5, 1.0, 'Semester view of sales')
```



2. Statistical Model For Store 1 – Build prediction models to forecast demand
3. 1 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 [86]:
```
x=data.drop(["Weekly_Sales","Date"],axis=1)
y=data["Weekly_Sales"]
```

In [87]:
```
linreg=LinearRegression(n_jobs=-1)
```

In [97]:
```
xtrain,xtest,ytrain,ytest=model_selection.train_test_split(x,y,test_size=0.4,random_state=42)
```

In [98]:
```
linreg.fit(xtrain,ytrain)
```

Out[98]:
```
LinearRegression(n_jobs=-1)
```

In [99]:
```
linreg.intercept_
```

Out[99]:
```
84171361.04320985
```

In [100]:
```
linreg.coef_
```

Out[100]:
```
array([-15076.05743532,  14940.56392359,   -744.77138548,  49882.84830669,
        -2178.75498529, -26725.92004156,  -1452.88018785,  11680.40062841,
       -40959.56523516])
```

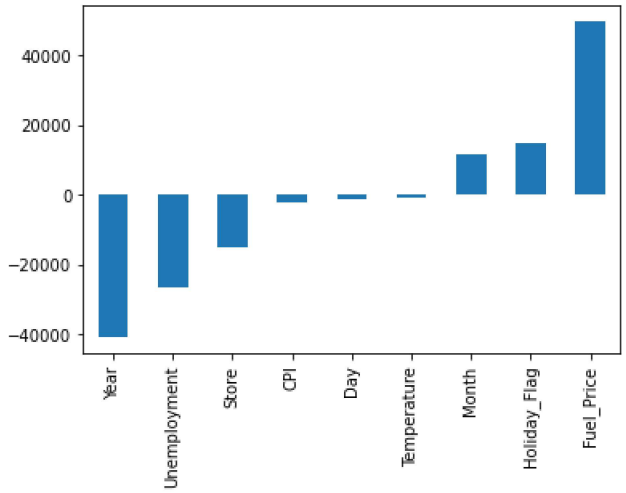
In [101]:
```
x.columns
```

Out[101]:
```
Index(['Store', 'Holiday_Flag', 'Temperature', 'Fuel_Price', 'CPI',
       'Unemployment', 'Day', 'Month', 'Year'],
      dtype='object')
```

In [102]:
```
features=['Store', 'Holiday_Flag', 'Temperature', 'Fuel_Price', 'CPI', 'Unemployment', 'Year', 'Month
```

In [103]:
```
relation=pd.Series(linreg.coef_,x.columns).sort_values()
relation.plot(kind="bar")
```

Out[103]:
```
<AxesSubplot:>
```



In [104]:
```
linreg.score(xtest,ytest)
```

Out[104]:
```
0.14950449647465935
```

In [106]:
```
sqrt(mean_squared_error(ytrain,linreg.predict(xtrain)))
```

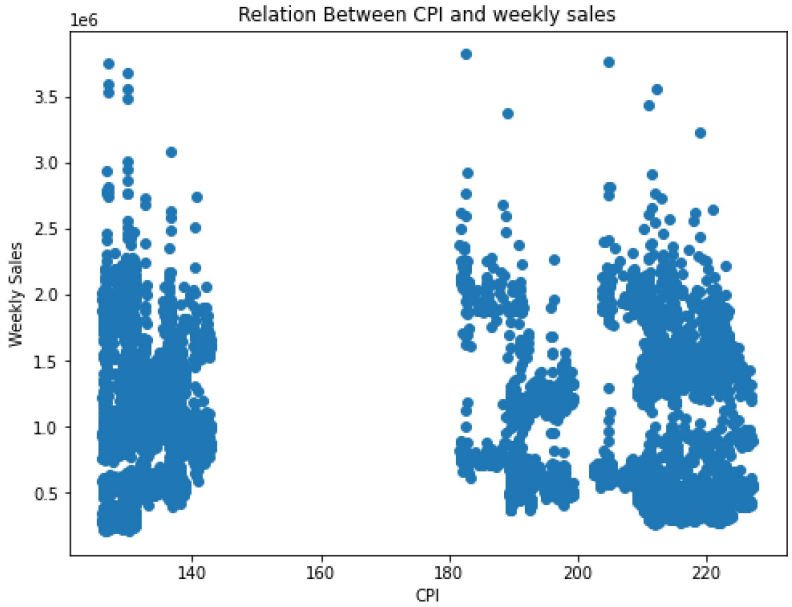
Out[106]:
```
522476.3098596038
```

In [107]:
```
mean_squared_error(ytest,linreg.predict(xtest))
```

Out[107]:
```
270207867997.983
```

In [110]:
```
#Relation Between CPI and weekly sales

plt.figure(figsize=(8,6))
plt.scatter(data["CPI"],data["Weekly_Sales"])
plt.title("Relation Between CPI and weekly sales")
plt.xlabel("CPI")
plt.ylabel("Weekly Sales")
```

Out[110]:
```
Text(0, 0.5, 'Weekly Sales')
```

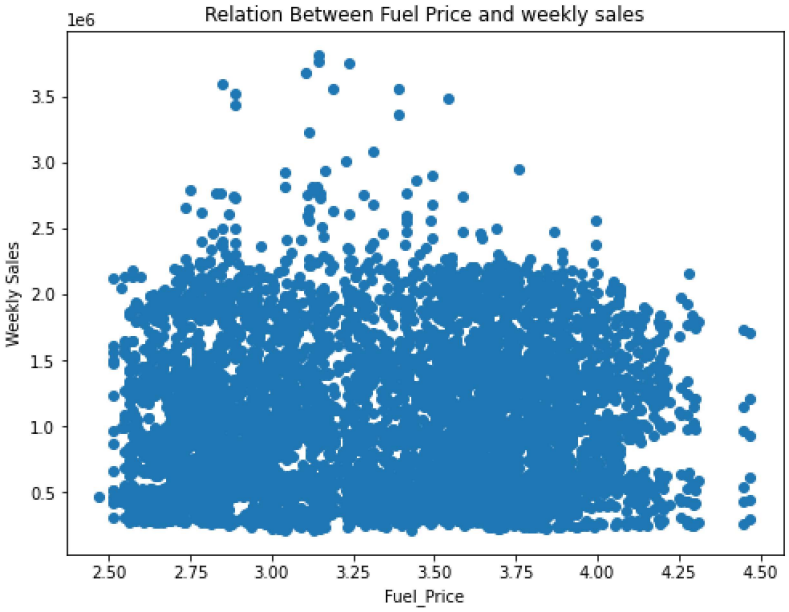


In [112]:
```
#Relation Between Unemployment and weekly sales

plt.figure(figsize=(8,6))
plt.scatter(data["Unemployment"],data["Weekly_Sales"])
plt.title("Relation Between Unemployment and weekly sales")
plt.xlabel("Unemployment")
plt.ylabel("Weekly Sales")
```

Out[112]:
```
Text(0, 0.5, 'Weekly Sales')
```

In [114]:
```
#Relation Between Fuel Price and weekly sales
plt.figure(figsize=(8,6))
plt.scatter(data["Fuel_Price"],data["Weekly_Sales"])
plt.title("Relation Between Fuel Price and weekly sales")
plt.xlabel("Fuel_Price")
plt.ylabel("Weekly Sales")
```

Out[114]:
```
Text(0, 0.5, 'Weekly Sales')
```



2. 2 Change dates into days by creating new variable.

In [115]:
```
data['days'] = data['Date'].dt.day_name()
```

In [116]:
```
data
```

Out[116]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment	Day	Month	Year
0	1	2010-05-02	1643690.90	0	42.31	2.572	211.096358	8.106	2	5	2010
1	1	2010-12-02	1641957.44	1	38.51	2.548	211.242170	8.106	2	12	2010
2	1	2010-02-19	1611968.17	0	39.93	2.514	211.289143	8.106	19	2	2010
3	1	2010-02-26	1409727.59	0	46.63	2.561	211.319643	8.106	26	2	2010
4	1	2010-05-03	1554806.68	0	46.50	2.625	211.350143	8.106	3	5	2010
...	...	...	...	...	...	...	...	...	...	...	...
6430	45	2012-09-28	713173.95	0	64.88	3.997	192.013558	8.684	28	9	2012
6431	45	2012-05-10	733455.07	0	64.89	3.985	192.170412	8.667	10	5	2012
6432	45	2012-12-10	734464.36	0	54.47	4.000	192.327265	8.667	10	12	2012
6433	45	2012-10-19	718125.53	0	56.47	3.969	192.330854	8.667	19	10	2012
6434	45	2012-10-26	760281.43	0	58.85	3.882	192.308899	8.667	26	10	2012

6435 rows × 12 columns