In [3]:

```
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 [5]:

```
#loading my dataset
data = pd.read_csv("Walmart_Store_sales.csv")
```

In [6]:

```
data
```

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
...	...	...	...	...	...	...	...	...
6430	45	28-09-2012	713173.95	0	64.88	3.997	192.013558	8.684
6431	45	05-10-2012	733455.07	0	64.89	3.985	192.170412	8.667
6432	45	12-10-2012	734464.36	0	54.47	4.000	192.327265	8.667
6433	45	19-10-2012	718125.53	0	56.47	3.969	192.330854	8.667
6434	45	26-10-2012	760281.43	0	58.85	3.882	192.308899	8.667

6435 rows × 8 columns

In [8]:

```
#coverting date to datetime
data['Date'] = pd.to_datetime(data['Date'])
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   datetime64[ns]
 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: datetime64[ns](1), float64(5), int64(2)
memory usage: 402.2 KB
```

In [9]:

```
# checking for missing values
data.isnull().sum()
```

Out[9]:

```
Store           0
Date            0
Weekly_Sales    0
Holiday_Flag    0
Temperature     0
Fuel_Price      0
CPI             0
Unemployment    0
dtype: int64
```

In [10]:

```
# Splitting Date and create new columns (Day, Month, and Year)
data["Day"]= pd.DatetimeIndex(data['Date']).day
data["Month"]= pd.DatetimeIndex(data['Date']).month
data["Year"]= pd.DatetimeIndex(data['Date']).year
data
```

Out[10]:

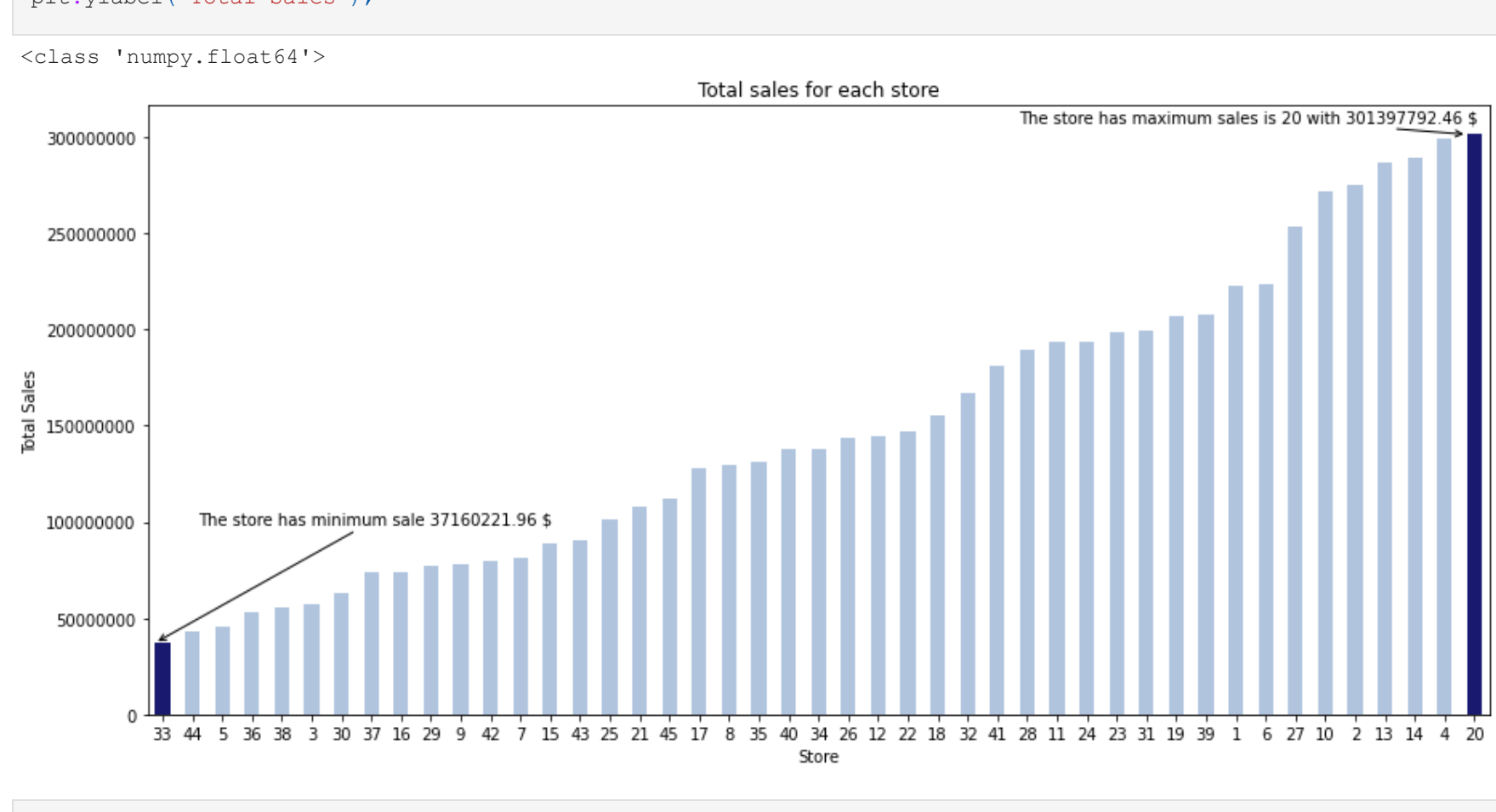
	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment	Day	Month	Year
0	1	2010-05-02	1643690.90	0	42.31	2.572	211.096358	8.106	2	5	2010
1	1	2010-12-02	1641957.44	1	38.51	2.548	211.242170	8.106	2	12	2010
2	1	2010-02-19	1611968.17	0	39.93	2.514	211.289143	8.106	19	2	2010
3	1	2010-02-26	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 × 11 columns

In [23]:

```
# Which store has minimum and maximum sales?

plt.figure(figsize=(15,7))

# Sum Weekly_Sales for each store, then sortded by total sales
total_sales_for_each_store = data.groupby('Store')['Weekly_Sales'].sum().sort_values()
total_sales_for_each_store_array = np.array(total_sales_for_each_store) # convert to array

# Assigning a specific color for the stores have the lowest and highest sales
clrs = ['lightsteelblue' if ((x < max(total_sales_for_each_store_array)) and (x > min(total_sales_for_each_stor


ax = total_sales_for_each_store.plot(kind='bar',color=clrs);


# store have minimum sales
p = ax.patches[0]
print(type(p.get_height()))
ax.annotate("The store has minimum sale {0:.2f} $".format((p.get_height())), xy=(p.get_x(), p.get_height()), xy
            xytext=(0.17, 0.32), textcoords='axes fraction',
            arrowprops=dict(arrowstyle="->", connectionstyle="arc3"),
            horizontalalignment='center', verticalalignment='center')


# store have maximum sales
p = ax.patches[44]
ax.annotate("The store has maximum sales is 20 with {0:.2f} $".format((p.get_height())), xy=(p.get_x(), p.get_h
            xytext=(0.82, 0.98), textcoords='axes fraction',
            arrowprops=dict(arrowstyle="->", connectionstyle="arc3"),
            horizontalalignment='center', verticalalignment='center')



# plot properties
plt.xticks(rotation=0)
plt.ticklabel_format(useOffset=False, style='plain', axis='y')
plt.title('Total sales for each store')
plt.xlabel('Store')
plt.ylabel('Total Sales');
```

```
<class 'numpy.float64'>
```



In [24]:

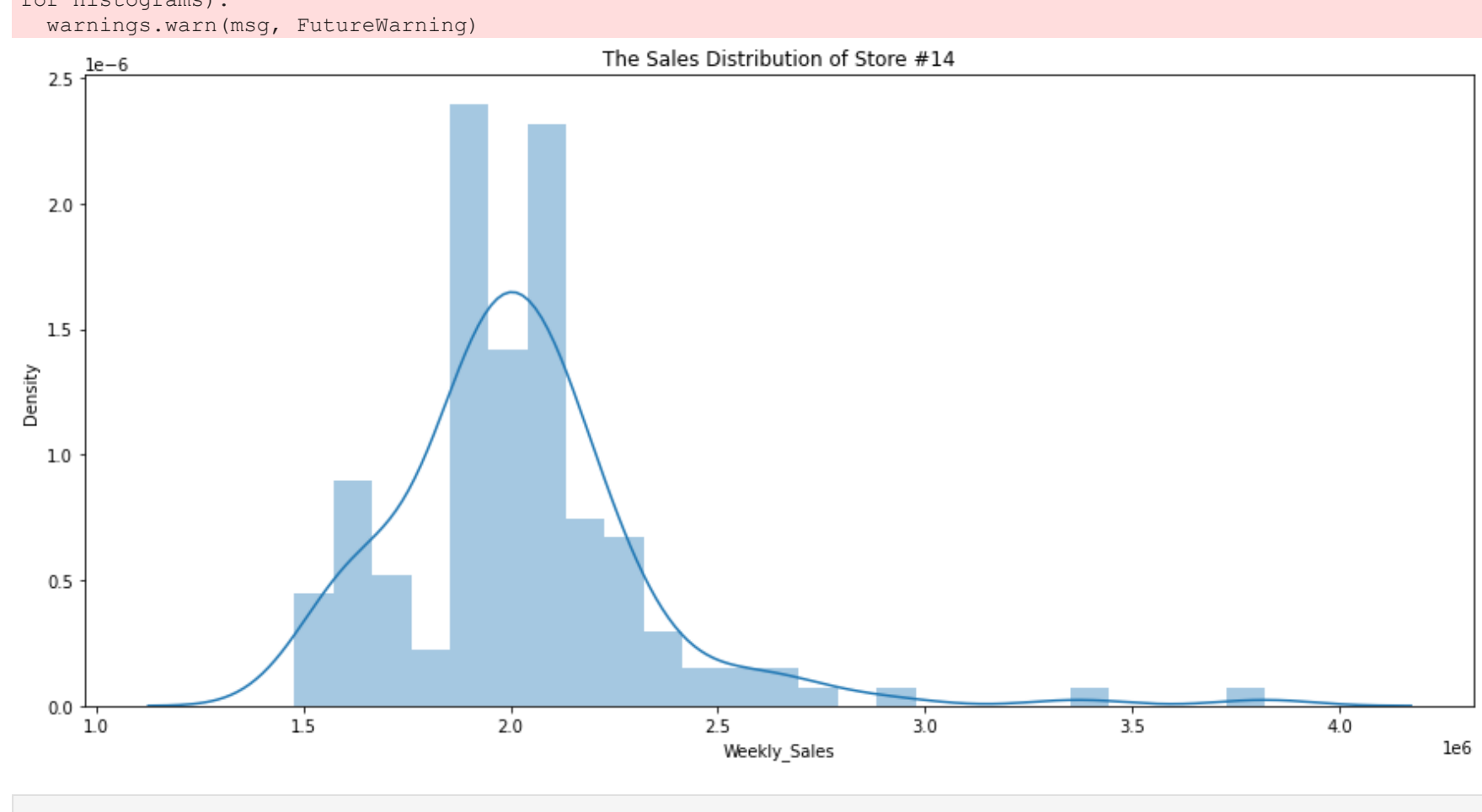
```
#Which store has maximum standard deviation i.e., the sales vary a lot. Also, find out the coefficient of mean
# Which store has maximum standard deviation
data_std = pd.DataFrame(data.groupby('Store')['Weekly_Sales'].std().sort_values(ascending=False))
print("The store has maximum standard deviation is "+str(data_std.head(1).index[0])+" with {0:.0f} $".format(da
```

```
The store has maximum standard deviation is 14 with 317570 $
```

In [25]:

```
# Distribution of store has maximum standard deviation
plt.figure(figsize=(15,7))
sns.distplot(data[data['Store'] == data_std.head(1).index[0]]['Weekly_Sales'])
plt.title('The Sales Distribution of Store #'+ str(data_std.head(1).index[0]));
```

```
c:\users\pinky\appdata\local\programs\python\python38-32\lib\site-packages\seaborn\distributions.py:2557: Futur
eWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code t
o use either `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function
for histograms).
  warnings.warn(msg, FutureWarning)
```



In [26]:

```
# Coefficient of mean to standard deviation
coef_mean_std = pd.DataFrame(data.groupby('Store')['Weekly_Sales'].std() / data.groupby('Store')['Weekly_Sales'
coef_mean_std = coef_mean_std.rename(columns={'Weekly_Sales':'Coefficient of mean to standard deviation'})
coef_mean_std
```

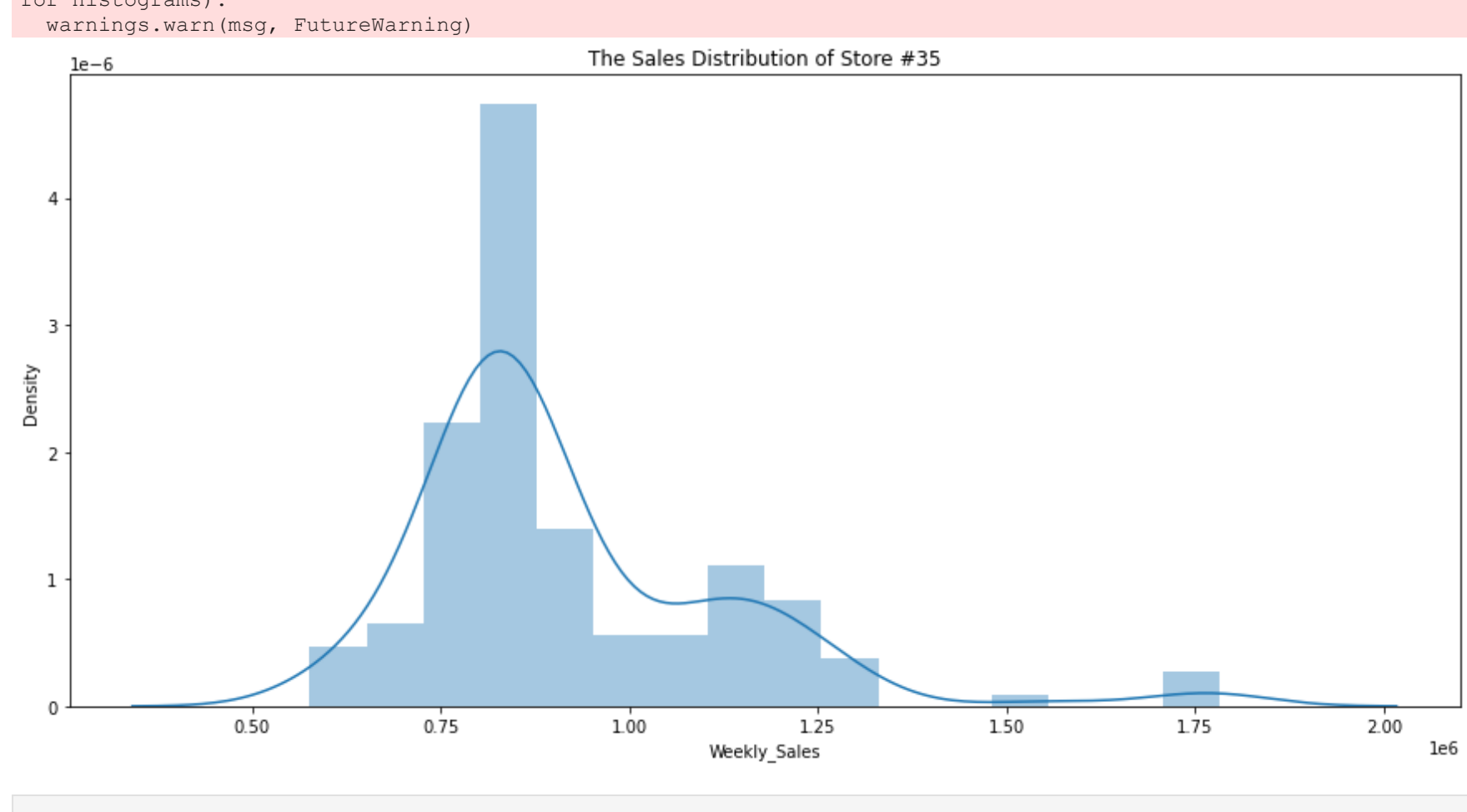
Out[26]:

	Coefficient of mean to standard deviation
Store	
1	0.100292
2	0.123424
3	0.115021
4	0.127083
5	0.118668
6	0.135823
7	0.197305
8	0.116953
9	0.126895
10	0.159133
11	0.122262
12	0.137925
13	0.132514
14	0.157137
15	0.193384
16	0.165181
17	0.125521
18	0.162845
19	0.132680
20	0.130903
21	0.170292
22	0.156783
23	0.179721
24	0.123637
25	0.159860
26	0.110111
27	0.135155
28	0.137330
29	0.183742
30	0.052008
31	0.090161
32	0.118310
33	0.092868
34	0.108225
35	0.229681
36	0.162579
37	0.042084
38	0.110875
39	0.149908
40	0.123430
41	0.148177
42	0.090335
43	0.064104
44	0.081793
45	0.165613

In [27]:

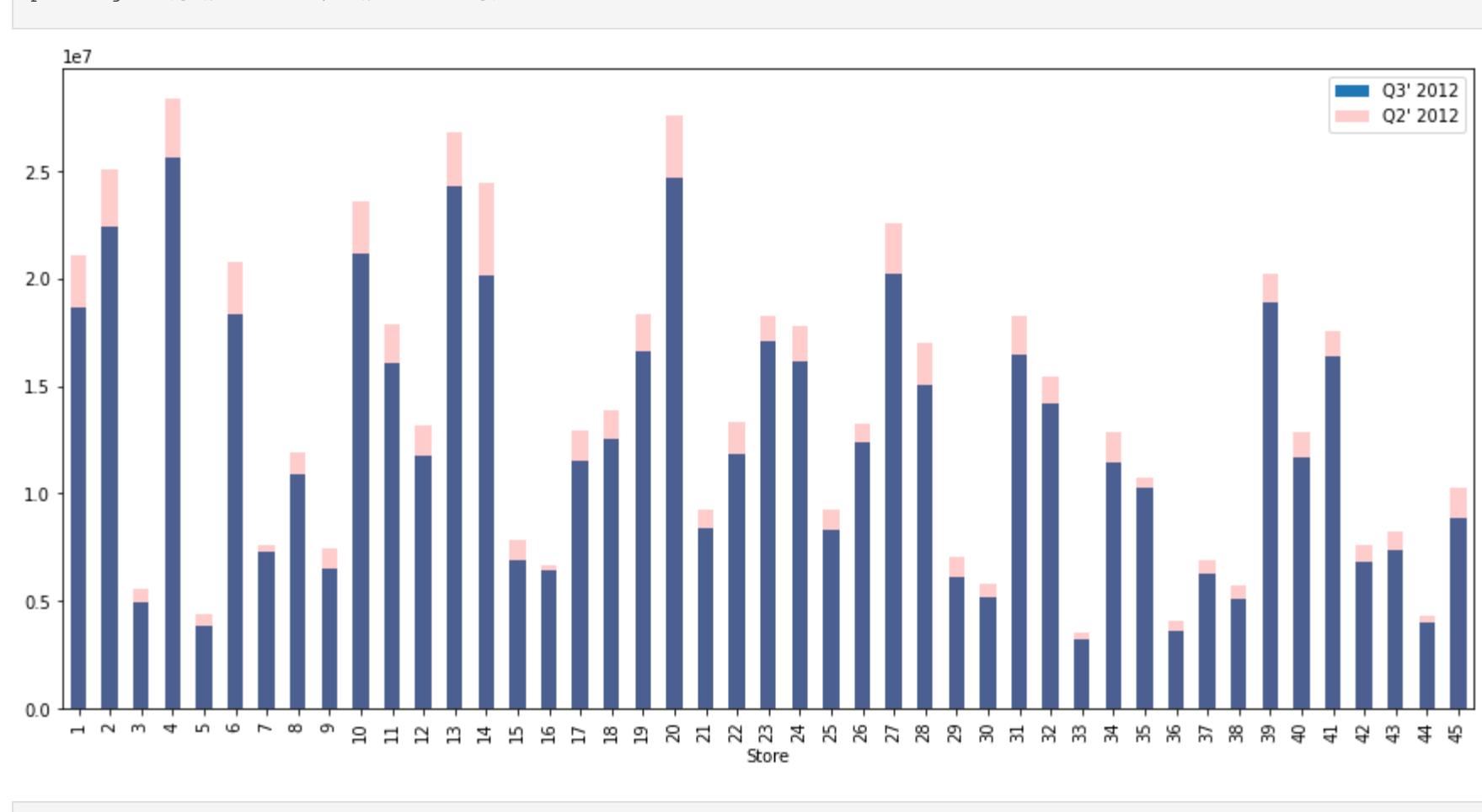
```
# Distribution of store has maximum coefficient of mean to standard deviation
coef_mean_std_max = coef_mean_std.sort_values(by='Coefficient of mean to standard deviation')
plt.figure(figsize=(15,7))
sns.distplot(data[data['Store'] == coef_mean_std_max.tail(1).index[0]]['Weekly_Sales'])
plt.title('The Sales Distribution of Store #'+str(coef_mean_std_max.tail(1).index[0]));
```

```
c:\users\pinky\appdata\local\programs\python\python38-32\lib\site-packages\seaborn\distributions.py:2557: Futur
eWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code t
o use either `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function
for histograms).
  warnings.warn(msg, FutureWarning)
```



In [29]:

```
#Which store/s has good quarterly growth rate in Q3'2012
plt.figure(figsize=(15,7))

# Sales for third quarterly in 2012
Q3 = data[(data['Date'] > '2012-07-01') & (data['Date'] < '2012-09-30')].groupby('Store')['Weekly_Sales'].sum()

# Sales for second quarterly in 2012
Q2 = data[(data['Date'] > '2012-04-01') & (data['Date'] < '2012-06-30')].groupby('Store')['Weekly_Sales'].sum()

# Plotting the difference between sales for second and third quarterly
Q2.plot(ax=Q3.plot(kind = 'bar',legend=True),kind='bar',color='r',alpha=0.2,legend=True);
plt.legend(["Q3' 2012", "Q2' 2012"]);
```



In [30]:

```
#  store/s has good quarterly growth rate in Q3'2012 - .sort_values(by='Weekly_Sales')
print('Store have good quarterly growth rate in Q3'2012 is Store '+str(Q3.idxmax())+' With '+str(Q3.max())+' $'
```

```
Store have good quarterly growth rate in Q3'2012 is Store 4 With 25652119.35 $
```

Q4: 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 Holiday Events:

Super Bowl: 12-Feb-10, 11-Feb-11, 10-Feb-12, 8-Feb-13

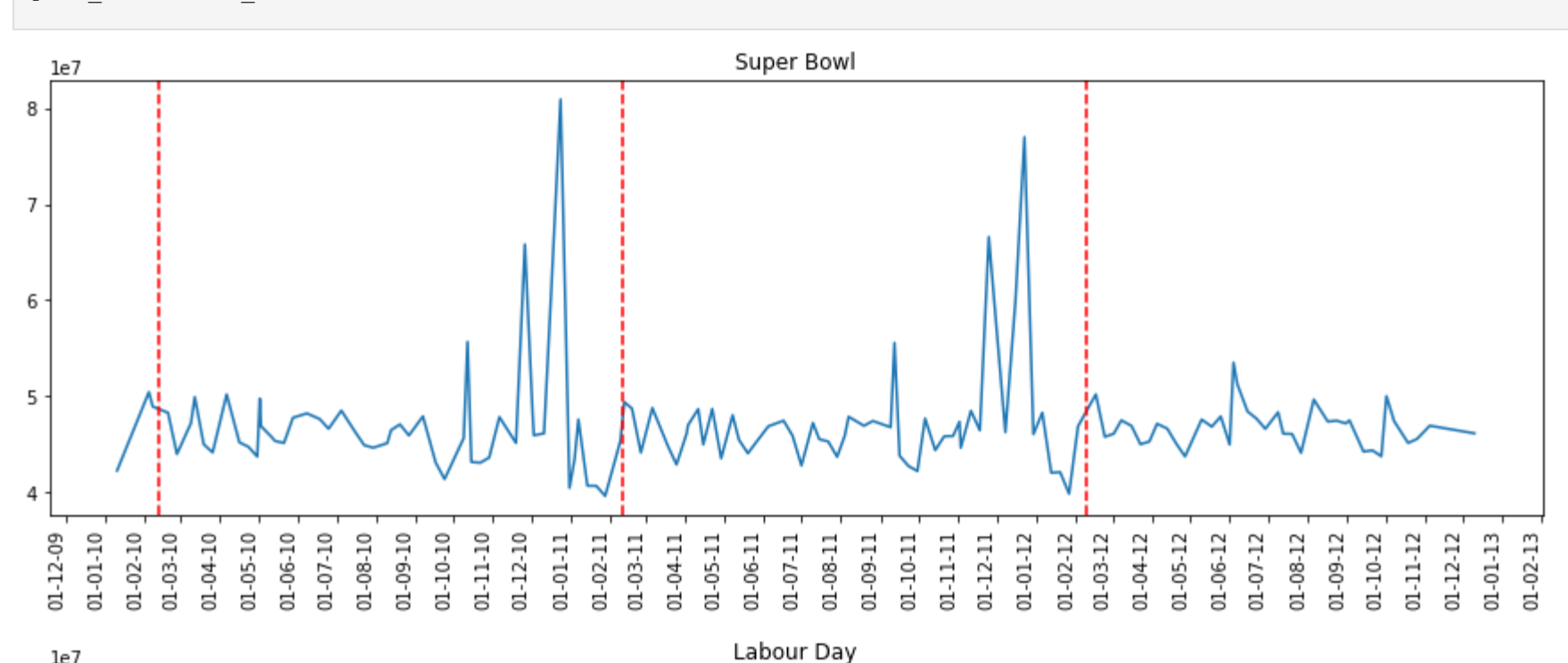
Labour Day: 10-Sep-10, 9-Sep-11, 7-Sep-12, 6-Sep-13

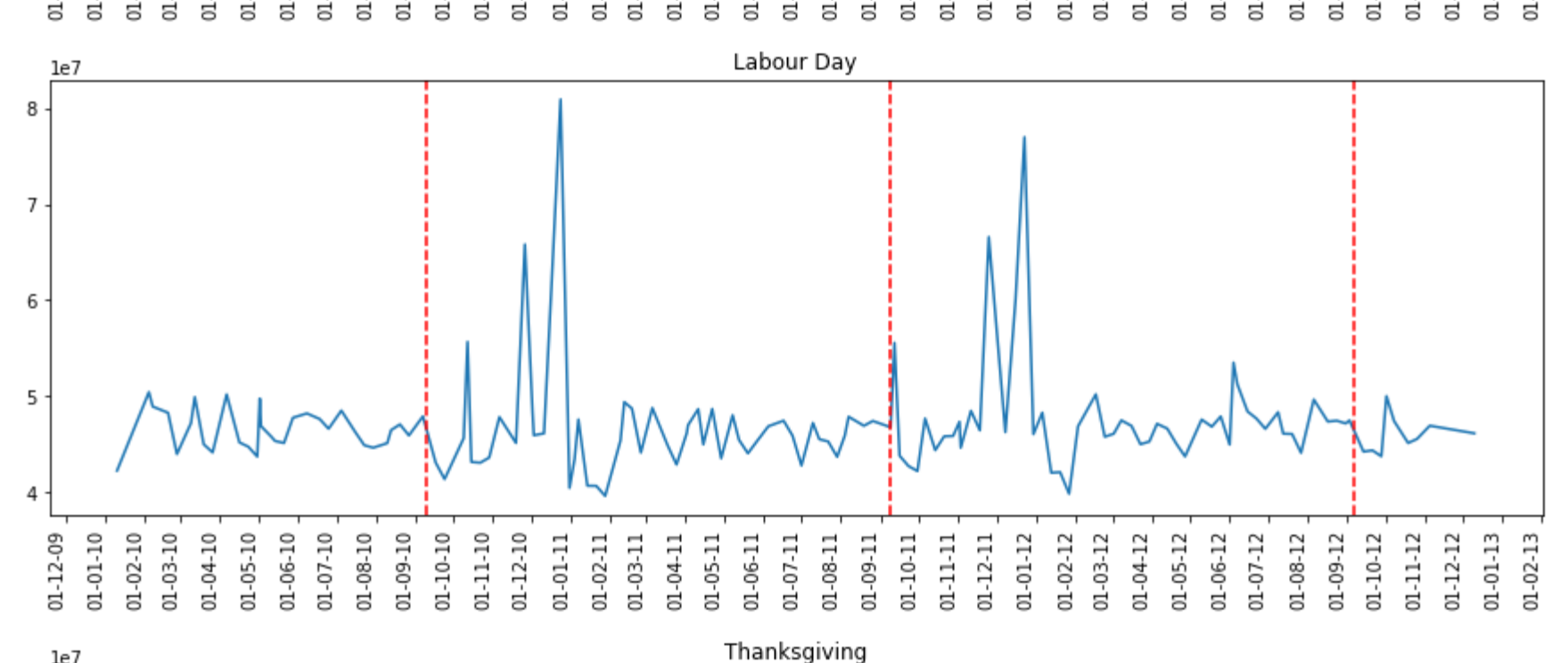
Thanksgiving: 26-Nov-10, 25-Nov-11, 23-Nov-12, 29-Nov-13

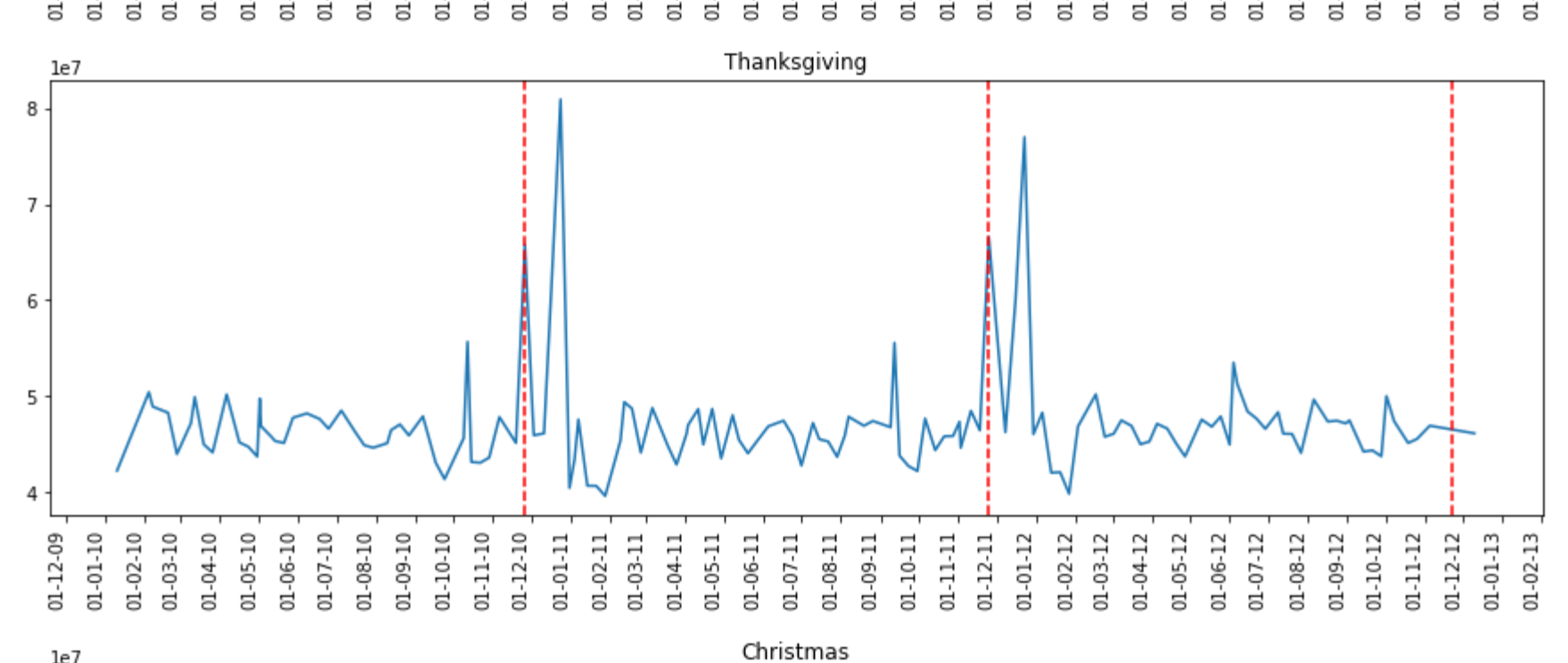
Christmas: 31-Dec-10, 30-Dec-11, 28-Dec-12, 27-Dec-13

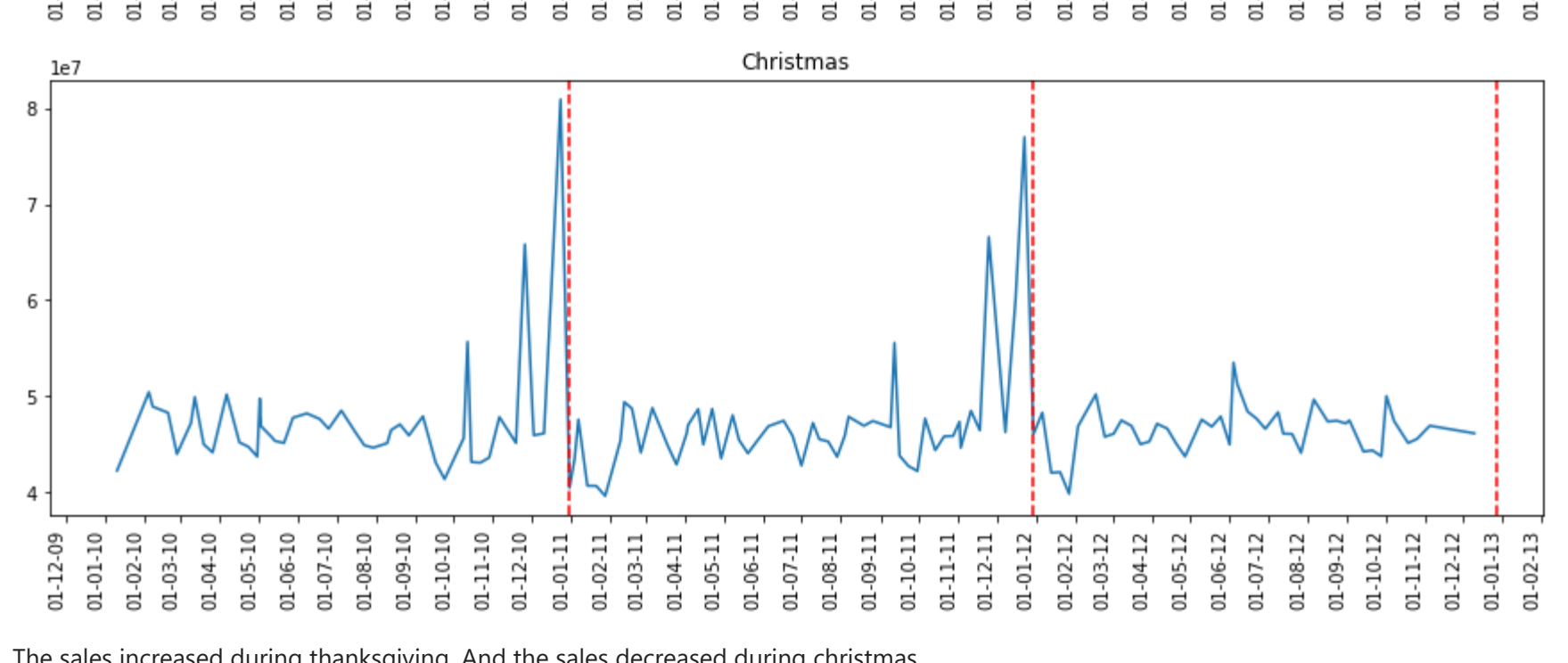
In [31]:

```
def plot_line(df,holiday_dates,holiday_label):
    fig, ax = plt.subplots(figsize = (15,5))
    ax.plot(df['Date'],df['Weekly_Sales'],label=holiday_label)

    for day in holiday_dates:
        day = datetime.strptime(day, '%d-%m-%Y')
        plt.axvline(x=day, linestyle='--', c='r')


    plt.title(holiday_label)
    x_dates = df['Date'].dt.strftime('%Y-%m-%d').sort_values().unique()
    xfmt = dates.DateFormatter('%d-%m-%y')
    ax.xaxis.set_major_formatter(xfmt)
    ax.xaxis.set_major_locator(dates.DayLocator(1))
    plt.gcf().autofmt_xdate(rotation=90)
    plt.show()


total_sales = data.groupby('Date')['Weekly_Sales'].sum().reset_index()
Super_Bowl =['12-2-2010', '11-2-2011', '10-2-2012']
Labour_Day =  ['10-9-2010', '9-9-2011', '7-9-2012']
Thanksgiving =  ['26-11-2010', '25-11-2011', '23-11-2012']
Christmas = ['31-12-2010', '30-12-2011', '28-12-2012']

plot_line(total_sales,Super_Bowl,'Super Bowl')
plot_line(total_sales,Labour_Day,'Labour Day')
plot_line(total_sales,Thanksgiving,'Thanksgiving')
plot_line(total_sales,Christmas,'Christmas')
```









The sales increased during thanksgiving. And the sales decreased during christmas.

In [32]:

```
data.loc[data.Date.isin(Super_Bowl)]
```

Out[32]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployment	Day	Month	Year
1	1	2010-12-02	1641957.44	1	38.51	2.548	211.242170	8.106	2	12	2010
53	1	2011-11-02	1649614.93	1	36.39	3.022	212.936705	7.742	2	11	2011
105	1	2012-10-02	1802477.43	1	48.02	3.409	220.265178	7.348	2	10	2012
144	2	2010-12-02	2137809.50	1	38.49	2.548	210.897994	8.324	2	12	2010
196	2	2011-11-02	2168041.61	1	33.19	3.022	212.592862	8.028	2	11	2011
...	...	...	...	...	...	...	...	...	...	...	...
6202	44	2011-11-02	307486.73	1	30.83	3.034	127.859129	7.224	2	11	2011
6254	44	2012-10-02	325377.97	1	33.73	3.116	130.384903	5.774	2	10	2012
6293	45	2010-12-02	656988.64	1	27.73	2.773	181.982317	8.992	2	12	2010
6345	45	2011-11-02	766456.00	1	30.30	3.239	183.701613	8.549	2	11	2011
6397	45	2012-10-02	803657.12	1	37.00	3.640	189.707605	8.424	2	10	2012

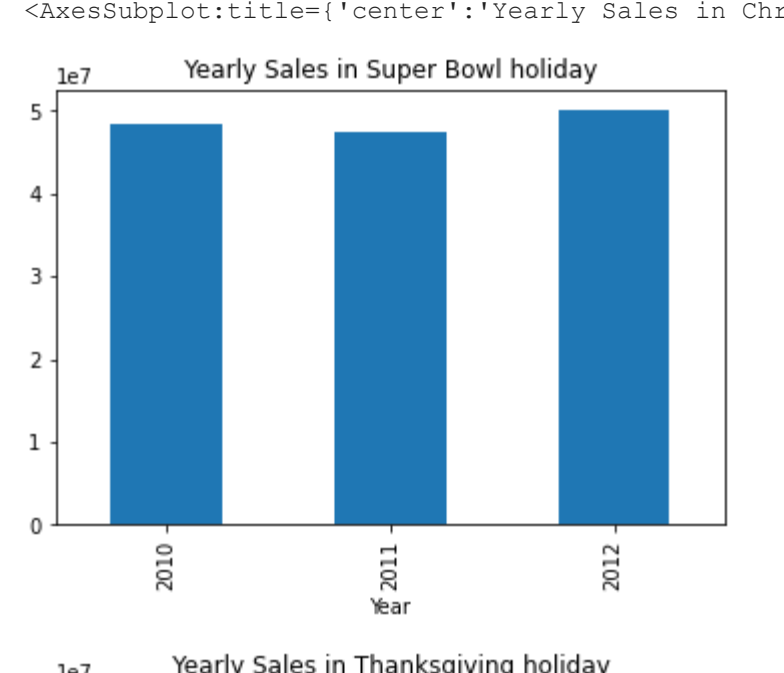
135 rows × 11 columns

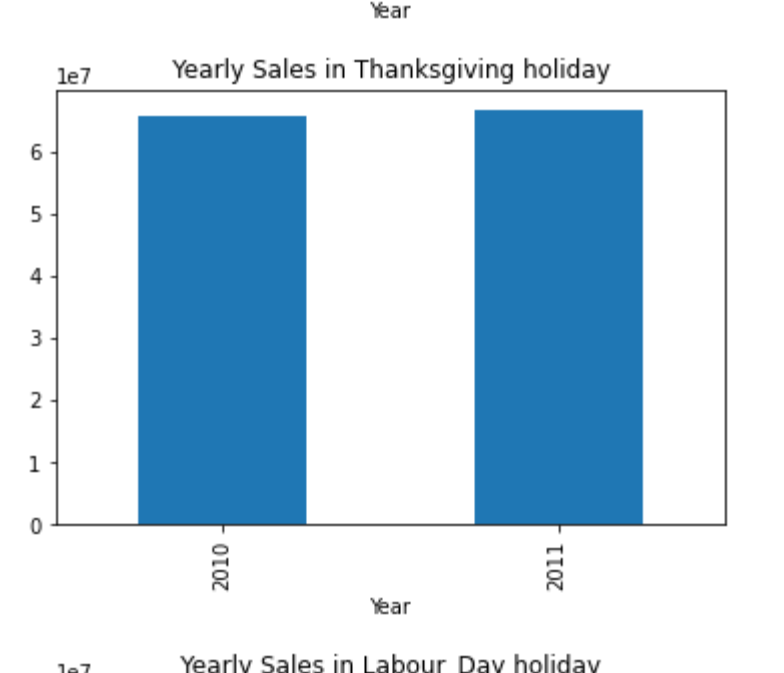
In [33]:

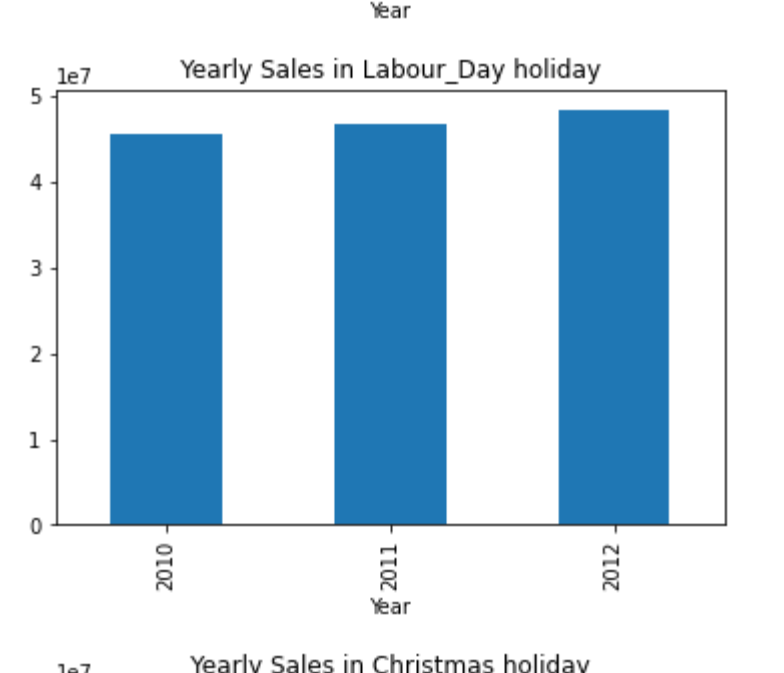
```
# Yearly Sales in holidays
Super_Bowl_df = pd.DataFrame(data.loc[data.Date.isin(Super_Bowl)].groupby('Year')['Weekly_Sales'].sum())
Thanksgiving_df = pd.DataFrame(data.loc[data.Date.isin(Thanksgiving)].groupby('Year')['Weekly_Sales'].sum())
Labour_Day_df = pd.DataFrame(data.loc[data.Date.isin(Labour_Day)].groupby('Year')['Weekly_Sales'].sum())
Christmas_df = pd.DataFrame(data.loc[data.Date.isin(Christmas)].groupby('Year')['Weekly_Sales'].sum())

Super_Bowl_df.plot(kind='bar',legend=False,title='Yearly Sales in Super Bowl holiday')
Thanksgiving_df.plot(kind='bar',legend=False,title='Yearly Sales in Thanksgiving holiday')
Labour_Day_df.plot(kind='bar',legend=False,title='Yearly Sales in Labour_Day holiday')
Christmas_df.plot(kind='bar',legend=False,title='Yearly Sales in Christmas holiday')
```

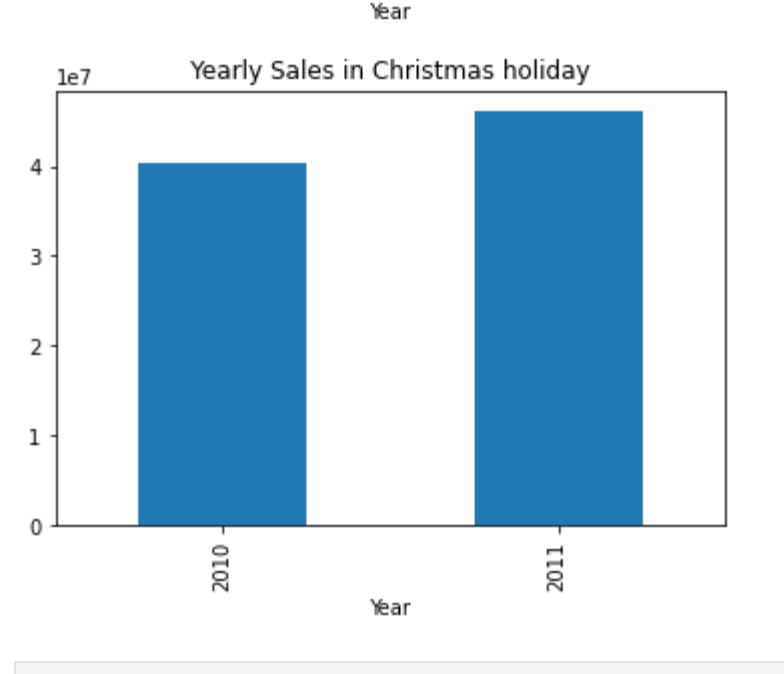
Out[33]:

```
<AxesSubplot:title={'center':'Yearly Sales in Christmas holiday'}, xlabel='Year'>
```



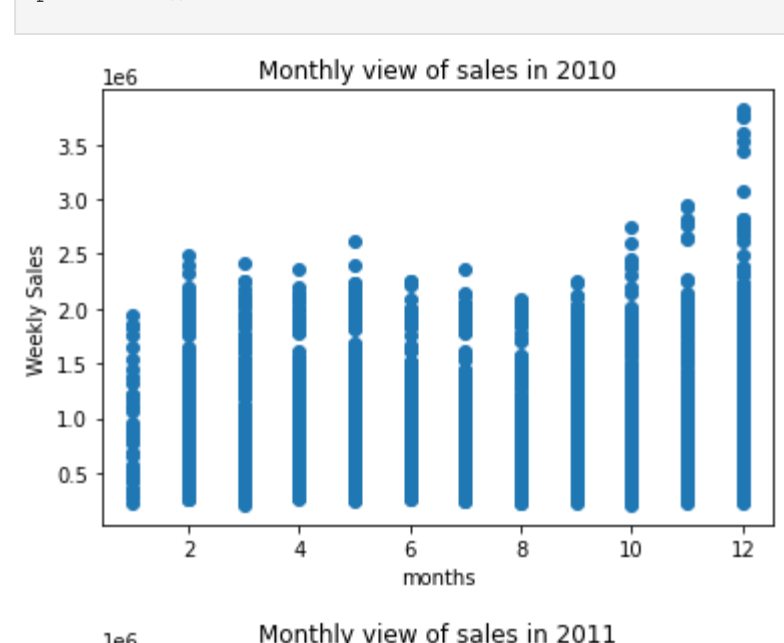


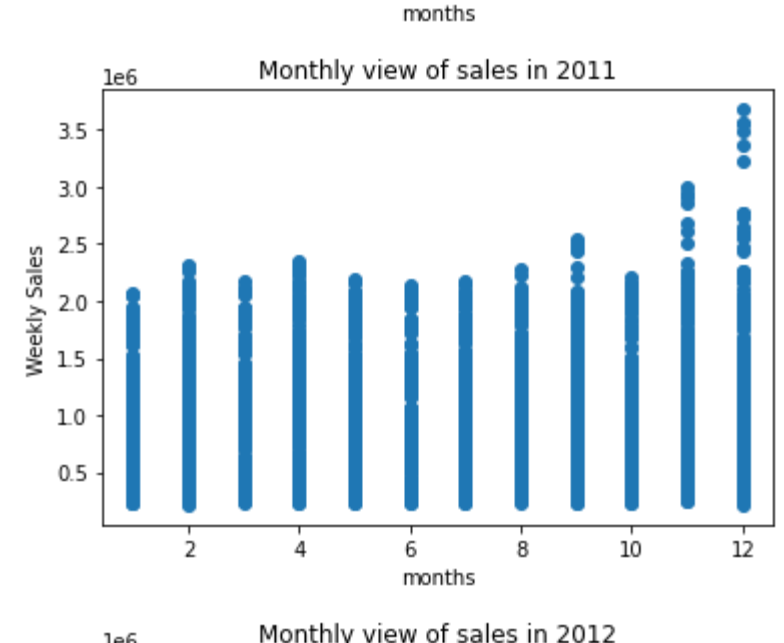


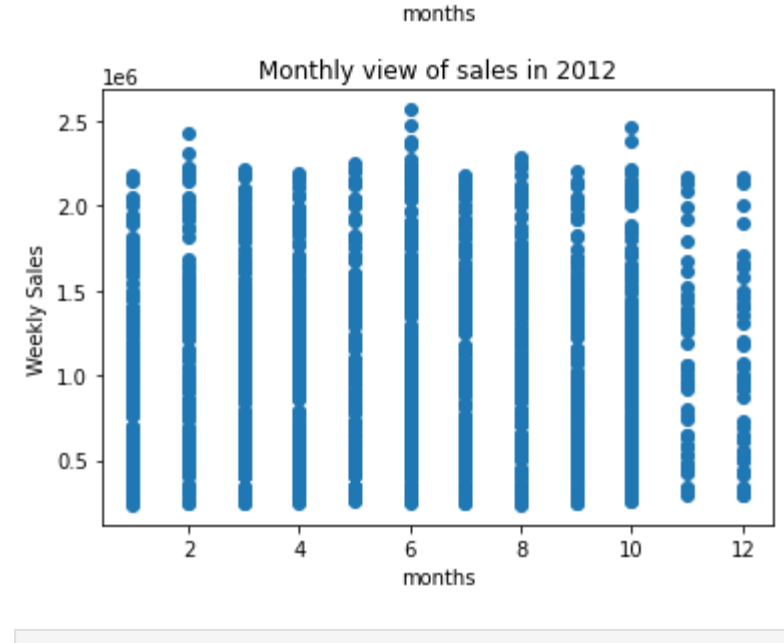


In [34]:

```
#Provide a monthly and semester view of sales in units and give insights
# Monthly view of sales for each years
plt.scatter(data[data.Year==2010]["Month"],data[data.Year==2010]["Weekly_Sales"])
plt.xlabel("months")
plt.ylabel("Weekly Sales")
plt.title("Monthly view of sales in 2010")
plt.show()

plt.scatter(data[data.Year==2011]["Month"],data[data.Year==2011]["Weekly_Sales"])
plt.xlabel("months")
plt.ylabel("Weekly Sales")
plt.title("Monthly view of sales in 2011")
plt.show()

plt.scatter(data[data.Year==2012]["Month"],data[data.Year==2012]["Weekly_Sales"])
plt.xlabel("months")
plt.ylabel("Weekly Sales")
plt.title("Monthly view of sales in 2012")
plt.show()
```





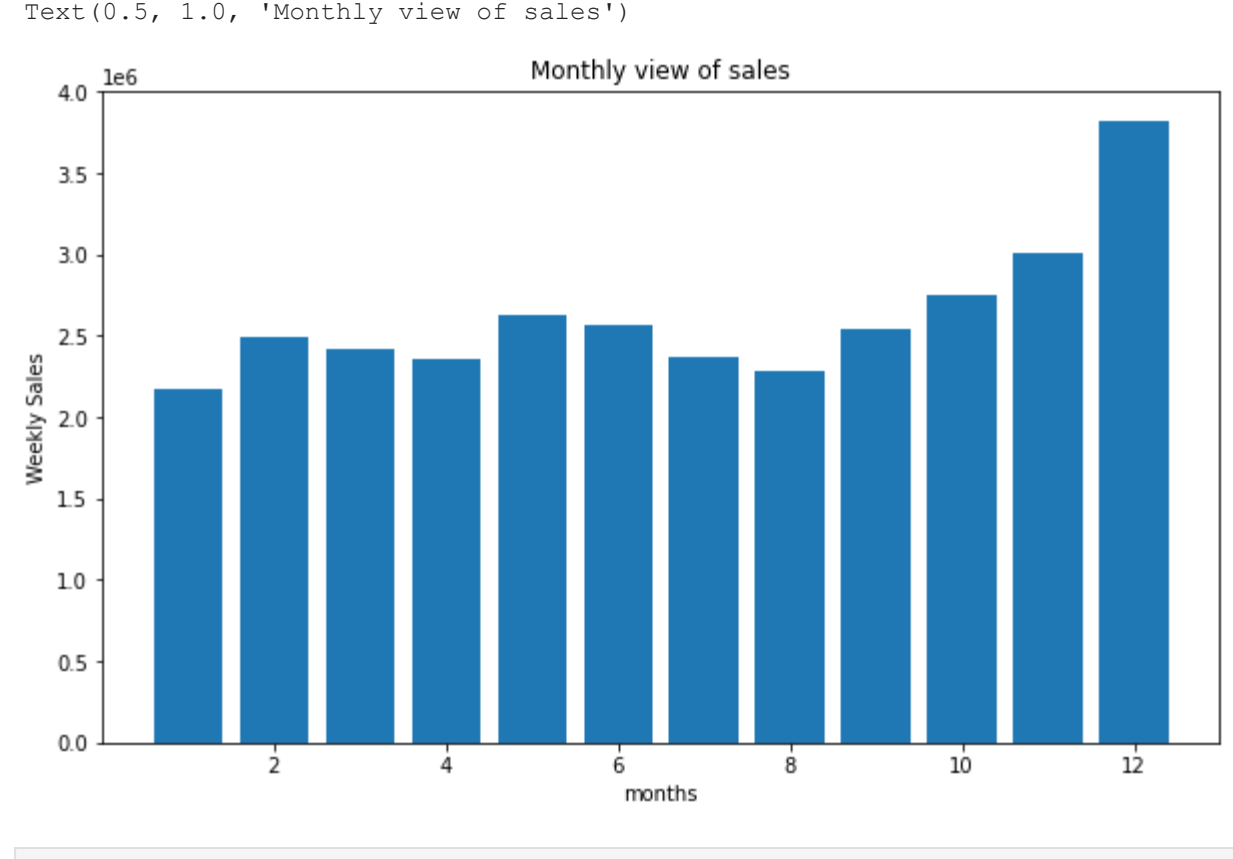


In [37]:

```
# Monthly view of sales for all years
plt.figure(figsize=(10,6))
plt.bar(data["Month"],data["Weekly_Sales"])
plt.xlabel("months")
plt.ylabel("Weekly Sales")
plt.title("Monthly view of sales")
```

Out[37]:

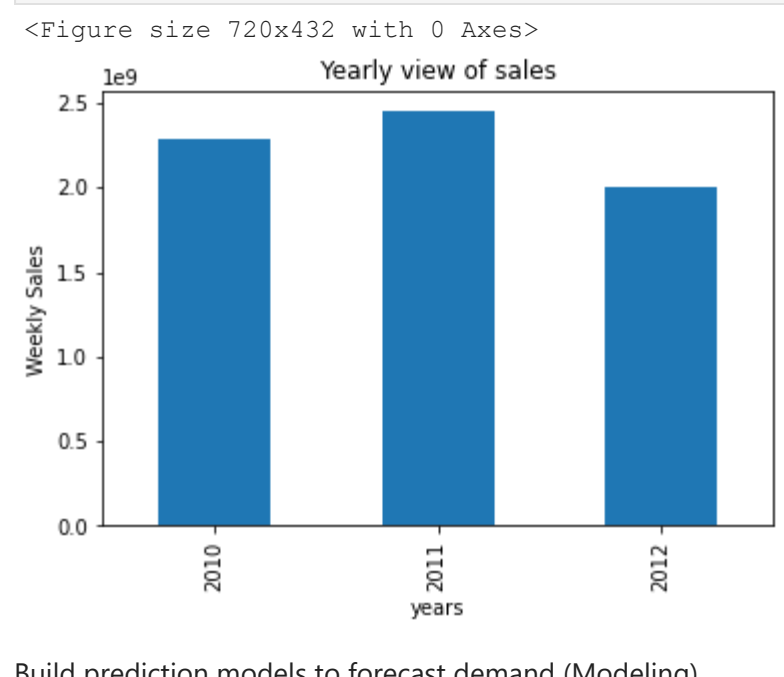
```
Text(0.5, 1.0, 'Monthly view of sales')
```



In [38]:

```
# Yearly view of sales
plt.figure(figsize=(10,6))
data.groupby("Year")[["Weekly_Sales"]].sum().plot(kind='bar',legend=False)
plt.xlabel("years")
plt.ylabel("Weekly Sales")
plt.title("Yearly view of sales");
```

```
<Figure size 720x432 with 0 Axes>
```

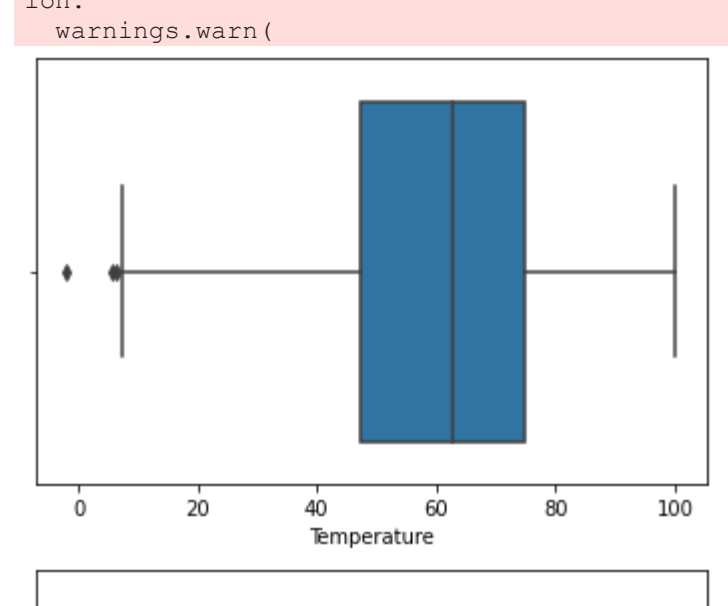


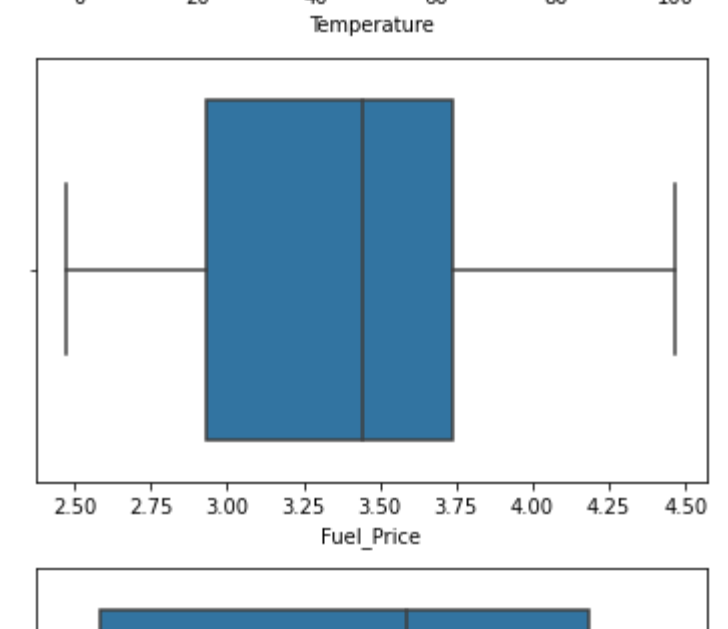
Build prediction models to forecast demand (Modeling)

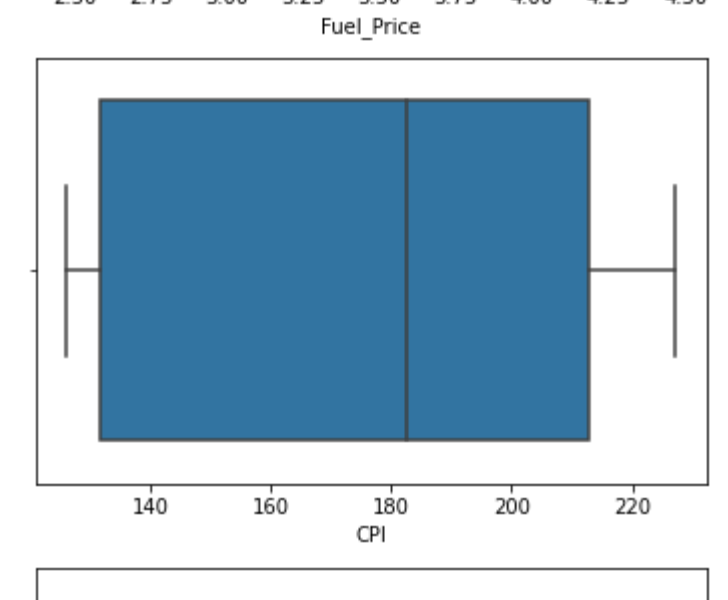
In [39]:

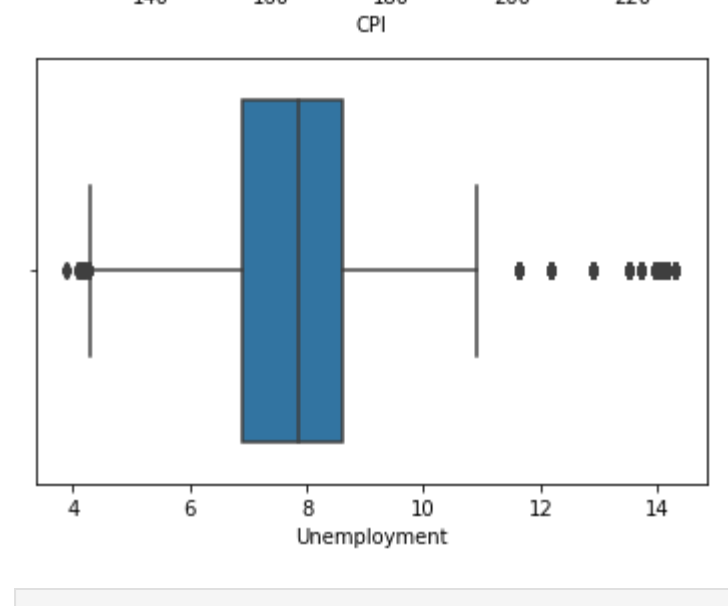
```
#Build prediction models to forecast demand (Modeling)
# find outliers
fig, axs = plt.subplots(4,figsize=(6,18))
X = data[['Temperature','Fuel_Price','CPI','Unemployment']]
for i,column in enumerate(X):
    sns.boxplot(data[column], ax=axs[i])
```

```
c:\users\pinky\appdata\local\programs\python\python38-32\lib\site-packages\seaborn\_decorators.py:36: FutureWar
ning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument wi
ll be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretat
ion.
  warnings.warn(
c:\users\pinky\appdata\local\programs\python\python38-32\lib\site-packages\seaborn\_decorators.py:36: FutureWar
ning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument wi
ll be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretat
ion.
  warnings.warn(
c:\users\pinky\appdata\local\programs\python\python38-32\lib\site-packages\seaborn\_decorators.py:36: FutureWar
ning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument wi
ll be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretat
ion.
  warnings.warn(
c:\users\pinky\appdata\local\programs\python\python38-32\lib\site-packages\seaborn\_decorators.py:36: FutureWar
ning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument wi
ll be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretat
ion.
  warnings.warn(
```









In [40]:

```
# drop the outliers
data_new = data[(data['Unemployment']<10) & (data['Unemployment']>4.5) & (data['Temperature']>10)]
data_new
```

Out[40]:

	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

5658 rows × 11 columns

In [41]:

```
# check outliers
fig, axs = plt.subplots(4,figsize=(6,18))
X = data_new[['Temperature','Fuel_Price','CPI','Unemployment']]
for i,column in enumerate(X):
    sns.boxplot(data_new[column], ax=axs[i])
```

```
c:\users\pinky\appdata\local\programs\python\python38-32\lib\site-packages\seaborn\_decorators.py:36: FutureWar
ning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument wi
ll be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretat
ion.
  warnings.warn(
c:\users\pinky\appdata\local\programs\python\python38-32\lib\site-packages\seaborn\_decorators.py:36: FutureWar
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c:\users\pinky\appdata\local\programs\python\python38-32\lib\site-packages\seaborn\_decorators.py:36: FutureWar
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ll be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretat
ion.
  warnings.warn(
```
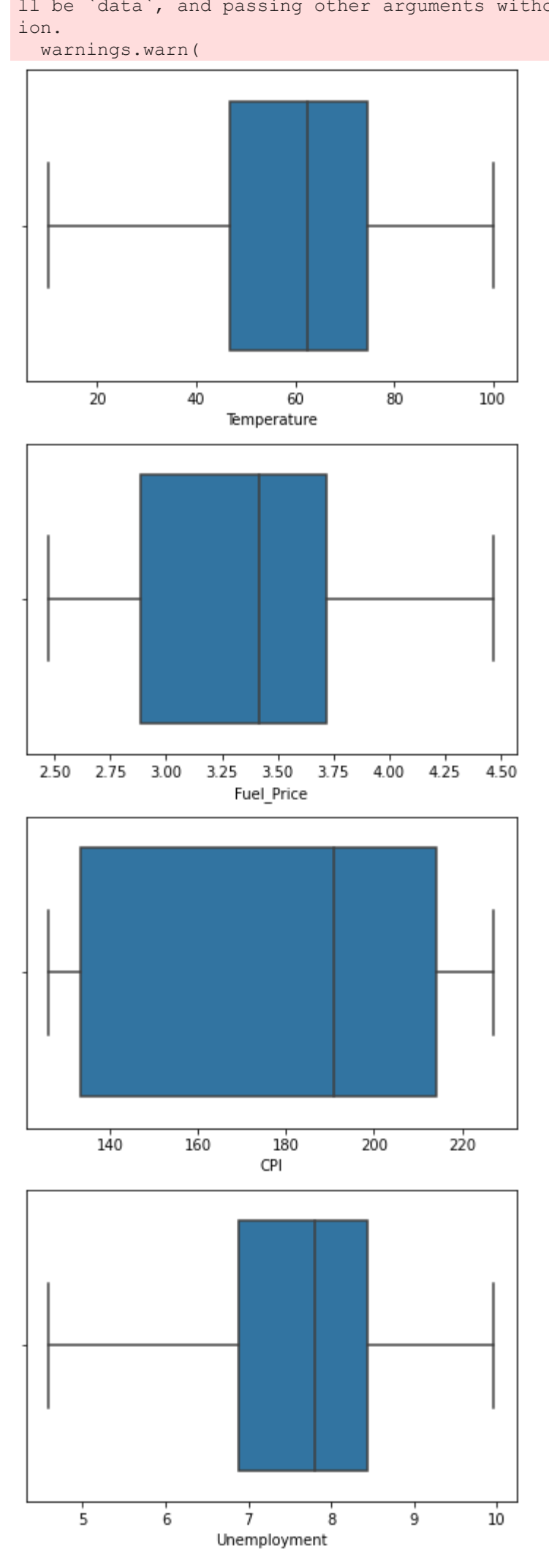



Build Model¶

In [42]:

```
# Import sklearn
from sklearn.ensemble import RandomForestRegressor
from sklearn.model_selection import train_test_split
from sklearn import metrics
from sklearn.linear_model import LinearRegression
```

In [43]:

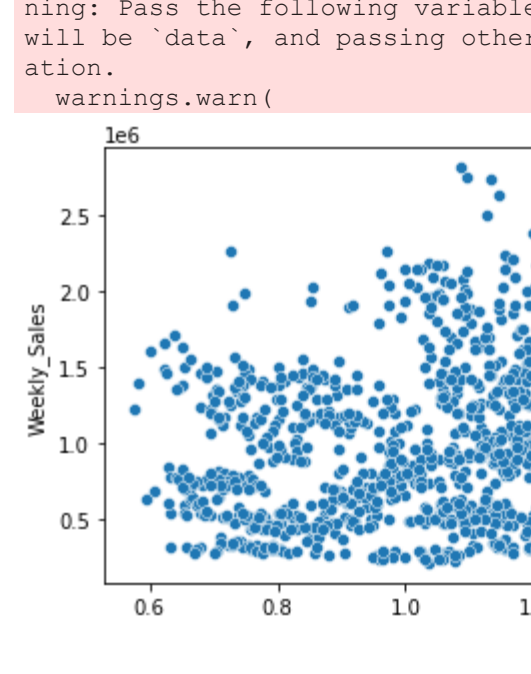
```
# Select features and target
X = data_new[['Store','Fuel_Price','CPI','Unemployment','Day','Month','Year']]
y = data_new['Weekly_Sales']

# Split data to train and test (0.80:0.20)
X_train, X_test, y_train, y_test = train_test_split(X,y,test_size=0.2)
```

In [44]:

```
# Linear Regression model
print('Linear Regression:')
print()
reg = LinearRegression()
reg.fit(X_train, y_train)
y_pred = reg.predict(X_test)
print('Accuracy:',reg.score(X_train, y_train)*100)


print('Mean Absolute Error:', metrics.mean_absolute_error(y_test, y_pred))
print('Mean Squared Error:', metrics.mean_squared_error(y_test, y_pred))
print('Root Mean Squared Error:', np.sqrt(metrics.mean_squared_error(y_test, y_pred)))


sns.scatterplot(y_pred, y_test);
```

```
Linear Regression:

Accuracy: 13.595934632491025
Mean Absolute Error: 457236.3752203463
Mean Squared Error: 297202845710.0466
Root Mean Squared Error: 545163.1367857208
```

```
c:\users\pinky\appdata\local\programs\python\python38-32\lib\site-packages\seaborn\_decorators.py:36: FutureWar
ning: Pass the following variables as keyword args: x, y. From version 0.12, the only valid positional argument
will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpret
ation.
  warnings.warn(
```

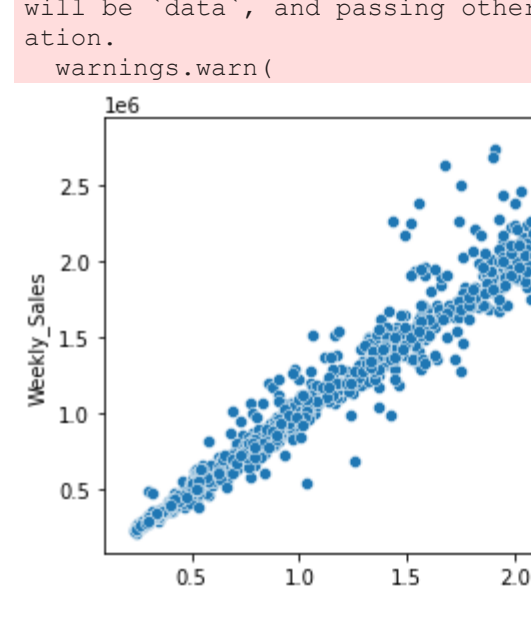


In [45]:

```
# Random Forest Regressor
print('Random Forest Regressor:')
print()
rfr = RandomForestRegressor(n_estimators = 400,max_depth=15,n_jobs=5)
rfr.fit(X_train,y_train)
y_pred=rfr.predict(X_test)
print('Accuracy:',rfr.score(X_test, y_test)*100)

print('Mean Absolute Error:', metrics.mean_absolute_error(y_test, y_pred))
print('Mean Squared Error:', metrics.mean_squared_error(y_test, y_pred))
print('Root Mean Squared Error:', np.sqrt(metrics.mean_squared_error(y_test, y_pred)))


sns.scatterplot(y_pred, y_test);
```

```
Random Forest Regressor:

Accuracy: 94.74683870342375
Mean Absolute Error: 69249.9213953039
Mean Squared Error: 17354445844.74118
Root Mean Squared Error: 131736.2738380784
```

```
c:\users\pinky\appdata\local\programs\python\python38-32\lib\site-packages\seaborn\_decorators.py:36: FutureWar
ning: Pass the following variables as keyword args: x, y. From version 0.12, the only valid positional argument
will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpret
ation.
  warnings.warn(
```



In [ ]: