Data Loading

In [1]:

```
import pandas as pd
import numpy as np
import datetime as dt
```

In [2]:

```
df = pd.read_csv('Walmart_Store_sales.csv')
```

In [3]:

```
df.shape
```

Out[3]:

```
(6435, 8)
```

In [4]:

```
df.isnull().sum()
```

Out[4]:

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

In [5]:

```
df.describe()
```

Out[5]:

	Store	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Uner
count	6435.000000	6.435000e+03	6435.000000	6435.000000	6435.000000	6435.000000	64
mean	23.000000	1.046965e+06	0.069930	60.663782	3.358607	171.578394	
std	12.988182	5.643666e+05	0.255049	18.444933	0.459020	39.356712	
min	1.000000	2.099862e+05	0.000000	-2.060000	2.472000	126.064000	
25%	12.000000	5.533501e+05	0.000000	47.460000	2.933000	131.735000	
50%	23.000000	9.607460e+05	0.000000	62.670000	3.445000	182.616521	
75%	34.000000	1.420159e+06	0.000000	74.940000	3.735000	212.743293	
max	45.000000	3.818686e+06	1.000000	100.140000	4.468000	227.232807	

In [6]:

```
df.info()
```

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

Observations:

```
 * date is in Object data type, need to change it to date formar for correc
 t data analysis
```

In [7]:

```
#Converting date into correct date and time format
```

In [8]:

```
df.head()
```

Out[8]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemp
0	1	05-02-2010	1643690.90	0	42.31	2.572	211.096358	
1	1	12-02-2010	1641957.44	1	38.51	2.548	211.242170	
2	1	19-02-2010	1611968.17	0	39.93	2.514	211.289143	
3	1	26-02-2010	1409727.59	0	46.63	2.561	211.319643	
4	1	05-03-2010	1554806.68	0	46.50	2.625	211.350143	

In [9]:

```
df['date'] = pd.to_datetime(df['Date'],format='%d-%m-%Y')
df[['date']].info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6435 entries, 0 to 6434
Data columns (total 1 columns):
date    6435 non-null datetime64[ns]
dtypes: datetime64[ns](1)
memory usage: 50.4 KB
```

In [10]:
```
df.head()
```

Out[10]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemp
0	1	05-02-2010	1643690.90	0	42.31	2.572	211.096358	
1	1	12-02-2010	1641957.44	1	38.51	2.548	211.242170	
2	1	19-02-2010	1611968.17	0	39.93	2.514	211.289143	
3	1	26-02-2010	1409727.59	0	46.63	2.561	211.319643	
4	1	05-03-2010	1554806.68	0	46.50	2.625	211.350143	

In [11]:
```
#checking that the datetime col is formatted correctly and applying dat
etie methods
df.loc[1,'date'].day_name()
```

Out[11]:
```
'Friday'
```

In [12]:

```
# create a list of our conditions
conditions = [
    (df['Date'] == '12-02-2010') | (df['Date'] == "11-02-2011") | (df['Date'] == "10-02-2012") | (df['Date'] == "08-02-2013"),
    (df['Date'] == '10-09-2010') | (df['Date'] == "09-09-2011") | (df['Date'] == "07-09-2012") | (df['Date'] == "06-09-2013"),
    (df['Date'] == '26-11-2010') | (df['Date'] == "25-11-2011") | (df['Date'] == "23-11-2012") | (df['Date'] == "29-11-2013"),
    (df['Date'] == '31-12-2010') | (df['Date'] == "30-12-2011") | (df['Date'] == "28-12-2012") | (df['Date'] == "27-12-2013"),

    (df['Date'] != '12-02-2010') | (df['Date'] != "11-02-2011") | (df['Date'] != "10-02-2012") | (df['Date'] != "08-02-2013"),
    (df['Date'] != '10-09-2010') | (df['Date'] != "09-09-2011") | (df['Date'] != "07-09-2012") | (df['Date'] != "06-09-2013"),
    (df['Date'] != '26-11-2010') | (df['Date'] != "25-11-2011") | (df['Date'] != "23-11-2012") | (df['Date'] != "29-11-2013"),
    (df['Date'] != '31-12-2010') | (df['Date'] != "30-12-2011") | (df['Date'] != "28-12-2012") | (df['Date'] != "27-12-2013")

    ]

# create a list of the values we want to assign for each condition
values = ['Super Bowl', 'Labour Day', 'Thanksgiving', 'Christmas','Non Holiday Week','Non Holiday Week','Non Holiday Week','Non Holiday Week']

# create a new column and use np.select to assign values to it using our lists as arguments
df['Holiday_category'] = np.select(conditions, values)

# display updated DataFrame
df.head()
#df.to_csv('dfwalmart.csv')
```

Out[12]:

	Store	Date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemp
0	1	05-02-2010	1643690.90	0	42.31	2.572	211.096358	
1	1	12-02-2010	1641957.44	1	38.51	2.548	211.242170	
2	1	19-02-2010	1611968.17	0	39.93	2.514	211.289143	
3	1	26-02-2010	1409727.59	0	46.63	2.561	211.319643	
4	1	05-03-2010	1554806.68	0	46.50	2.625	211.350143	

In [13]:

```
df['Weekly_Sales($M)'] = df['Weekly_Sales']/1000000
df['Year'] = pd.DatetimeIndex(df['date']).year
df['Month'] = pd.DatetimeIndex(df['date']).month
df['Quarter'] = df['date'].dt.quarter
```

In [14]:
```
df.head()
```

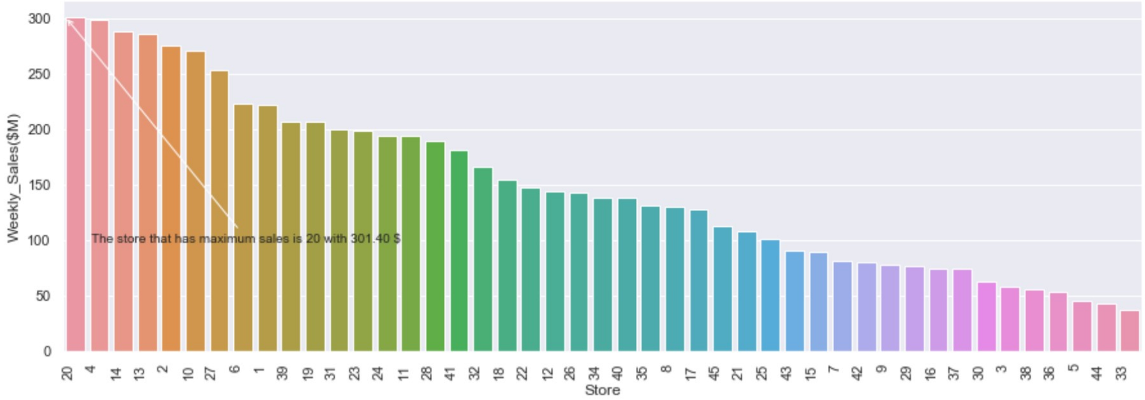
Out[14]:
```
   Store        Date  Weekly_Sales  Holiday_Flag  Temperature  Fuel_Price         CPI  Unem
0      1  05-02-2010    1643690.90             0        42.31       2.572  211.096358
1      1  12-02-2010    1641957.44             1        38.51       2.548  211.242170
2      1  19-02-2010    1611968.17             0        39.93       2.514  211.289143
3      1  26-02-2010    1409727.59             0        46.63       2.561  211.319643
4      1  05-03-2010    1554806.68             0        46.50       2.625  211.350143
```

Which store has maximum sales

In [15]:
```
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
sns.set()
```

In [16]:

```
# Overall Sales
pd.options.display.float_format = '{:,.2f}'.format
df_max_sales=df.groupby(['Store'])[['Weekly_Sales($M)']].sum().sort_val
ues('Weekly_Sales($M)',ascending=False).reset_index()


fig, axs = plt.subplots(figsize=(15,5))

ax0=sns.barplot(x='Store',y='Weekly_Sales($M)',data = df_max_sales,
            order=df_max_sales.sort_values('Weekly_Sales($M)',ascending
= False).Store)
ax0.set_xticklabels(ax0.get_xticklabels(), rotation=90, ha="right")

p = ax0.patches[0]
ax0.annotate("The store that has maximum sales is 20 with {0:.2f} $".fo
rmat((p.get_height())), xy=(p.get_x(), p.get_height()), xycoords='data
',
             xytext=(0.17, 0.32), textcoords='axes fraction',
             arrowprops=dict(arrowstyle="->", connectionstyle="arc3"),
             horizontalalignment='center', verticalalignment='center')

plt.show()

print('Store with Maximum Sales all years')
print(df_max_sales[df_max_sales['Weekly_Sales($M)']==df_max_sales['Week
ly_Sales($M)'].max()])

print('Store with Minimum Sales all years')
print(df_max_sales[df_max_sales['Weekly_Sales($M)']==df_max_sales['Week
ly_Sales($M)'].min()])
```



```
Store with Maximum Sales all years
   Store  Weekly_Sales($M)
0     20            301.40
Store with Minimum Sales all years
    Store  Weekly_Sales($M)
44     33             37.16
```

In [17]:

```
#Sales by Year
pd.options.display.float_format = '{:,.2f}'.format
df_max_sales_year=df.groupby(['Store','Year'])[['Weekly_Sales($M)']].sum().unstack().reset_index()
```

In [18]:

```
df_max_sales_year.columns = df_max_sales_year.columns.droplevel()
df_max_sales_year.rename(columns={'':'Store'}, inplace=True)
df_max_sales_year.set_index('Store',inplace=True)
```

In [19]:

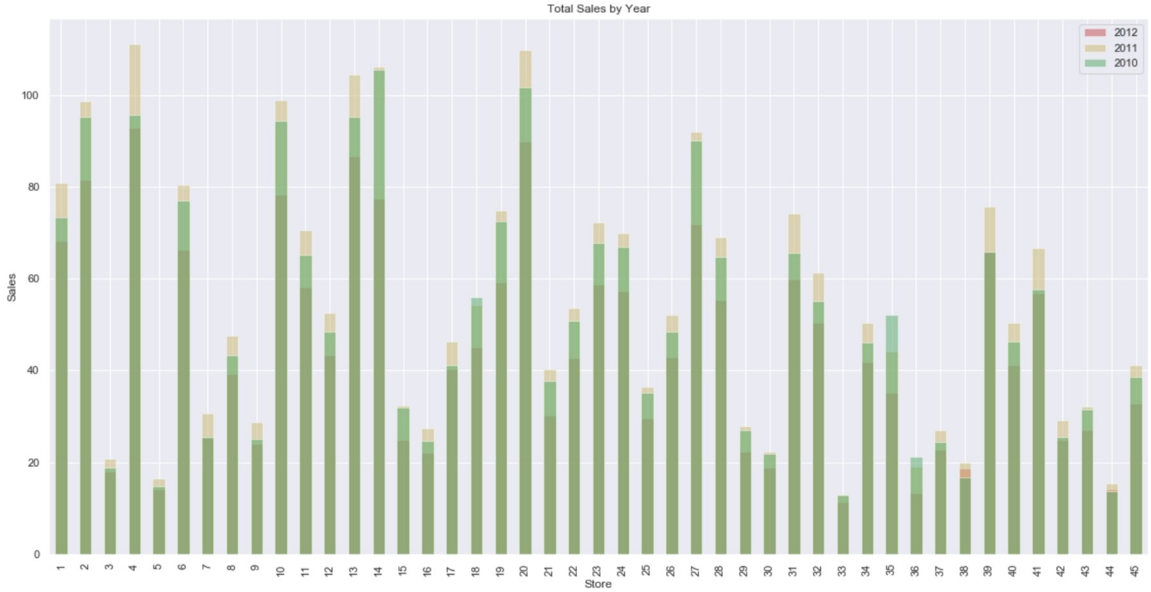
```
df_max_sales_year['Total']=df_max_sales_year[2010]+df_max_sales_year[2011]+df_max_sales_year[2012]
df_max_sales_year.sort_values('Total',ascending=False).head()
```

Out[19]:

Year	2010	2011	2012	Total
Store				
20	101.73	109.84	89.83	301.40
4	95.68	111.09	92.77	299.54
14	105.46	106.10	77.44	289.00
13	95.27	104.54	86.71	286.52
2	95.28	98.61	81.50	275.38

In [20]:

```
df_max_sales_year[2012].plot(kind='bar',stacked=True,figsize=(20, 10),
alpha=0.5,color='r')

df_max_sales_year[2011].plot(kind='bar',stacked=True,figsize=(20, 10),a
lpha=0.5, color='y')

df_max_sales_year[2010].plot(kind='bar',stacked=True,figsize=(20, 10),
alpha=0.5,color='g')

plt.title('Total Sales by Year')
plt.ylabel('Sales')
plt.xlabel('Store')
plt.legend()

plt.show()
```



In [ ]:

In [21]:

```
#Sales by Year
pd.options.display.float_format = '{:,.2f}'.format
df_max_sales_year1=df.groupby(['Store','Year'])[['Weekly_Sales($M)']].s
um().unstack().reset_index()
```

In [22]:

```
df_max_sales_year1.columns=df_max_sales_year1.columns.droplevel()
```

In [23]:

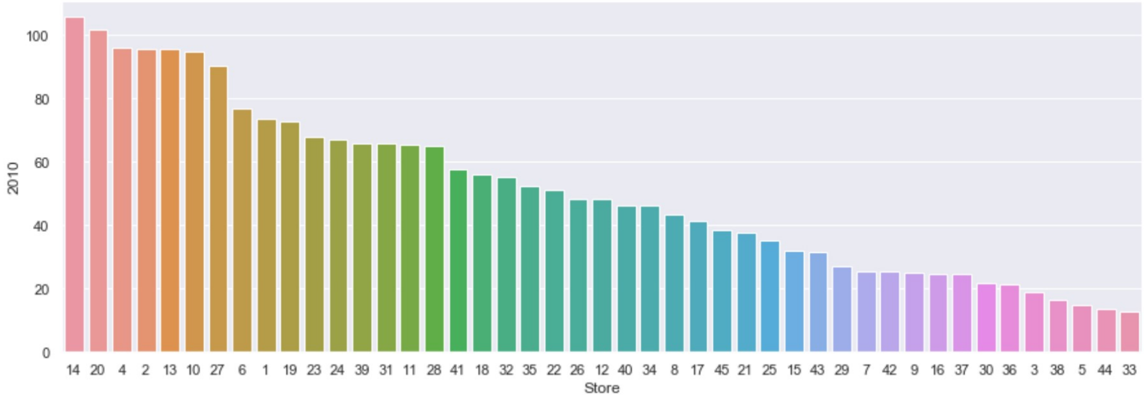
```
df_max_sales_year1.rename(columns={'':'Store'}, inplace=True)
```

In [24]:
```
df_max_sales_year1.head()
```

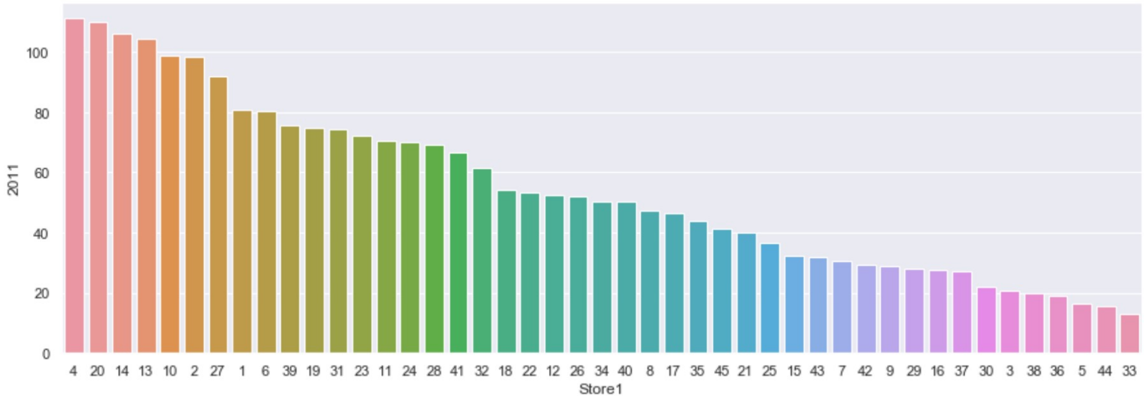
Out[24]:

Year	Store	2010	2011	2012
0	1	73.28	80.92	68.20
1	2	95.28	98.61	81.50
2	3	18.75	20.82	18.02
3	4	95.68	111.09	92.77
4	5	14.84	16.47	14.17

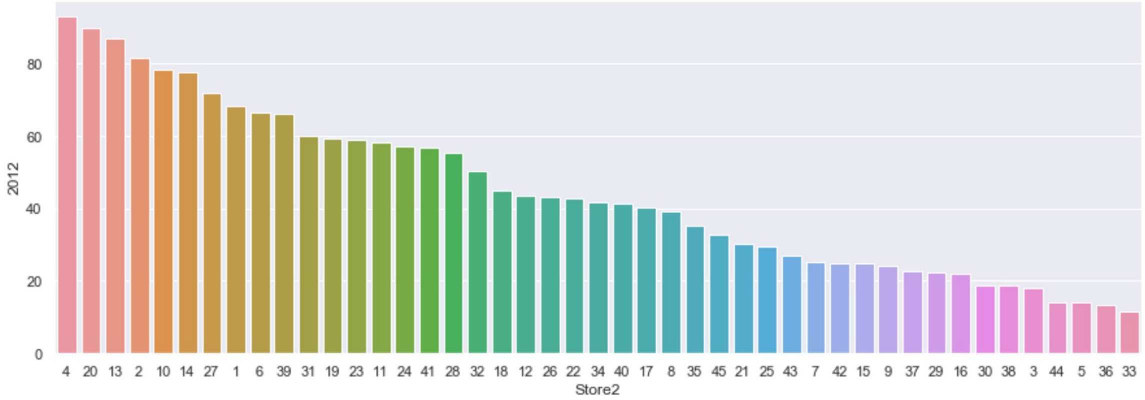
In [25]:
```
df_2010=df_max_sales_year1[['Store',2010]].sort_values(2010, ascending=
False)
plt.figure(figsize=(15,5))
sns.barplot(x='Store',y=2010, data =df_2010,
    order=df_2010.sort_values(2010,ascending = False).Store)
plt.show()
```



In [26]:
```
df_2011=df_max_sales_year1[['Store',2011]].sort_values(2011, ascending=
False)
df_2011.rename(columns={'Store':'Store1'}, inplace=True)

plt.figure(figsize=(15,5))
sns.barplot(x='Store1',y=2011, data =df_2011,
    order=df_2011.sort_values(2011,ascending = False).Store1)
plt.show()
```



In [27]:
```
df_2012=df_max_sales_year1[['Store',2012]].sort_values(2012, ascending=
False)
df_2012.rename(columns={'Store':'Store2'}, inplace=True)

plt.figure(figsize=(15,5))
sns.barplot(x='Store2',y=2012, data =df_2012,
    order=df_2012.sort_values(2012,ascending = False).Store2)
plt.show()
```



In [ ]:

Observations:

```
* if we look at the overall average sales across all yearss,  Store No. 20
has the maximum average Sales
* When we look at the Total sales by each Year, we again see, store, no 20
falls in the top 2 position
* it appears we do not have the Nov and Dec sales data for 2012 and its re
flecting in the total sales values for the 2012
```

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

In [28]:
```
df_std = df.groupby('Store').agg({'Weekly_Sales($M)':'std'})
```

In [29]:
```
df_std[df_std['Weekly_Sales($M)']==df_std['Weekly_Sales($M)'].max()]
```

Out[29]:

	Weekly_Sales($M)
Store	
14	0.32

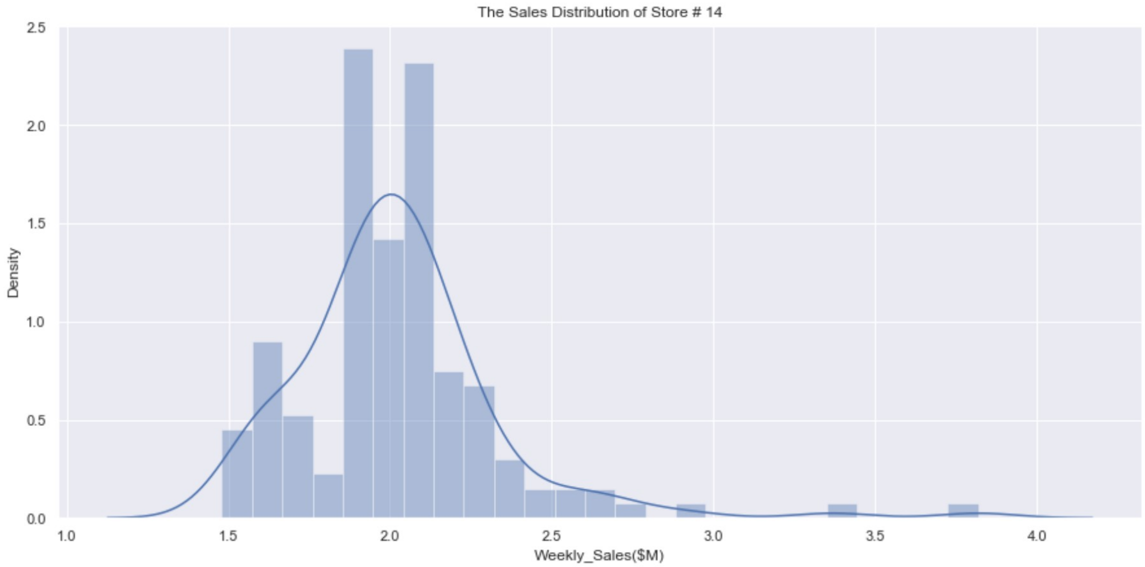
In [30]:

```
#Distribution of sales for Store number 14
plt.figure(figsize=(15,7))
sns.distplot(df[df['Store']==14]['Weekly_Sales($M)'])
plt.title('The Sales Distribution of Store # 14')
```

```
C:\Users\SujitSonar\Anaconda3\lib\site-packages\seaborn\distribution
s.py:2557: FutureWarning: `distplot` is a deprecated function and wil
l be removed in a future version. Please adapt your code to use eithe
r `displot` (a figure-level function with similar flexibility) or `hi
stplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```

Out[30]:

```
Text(0.5, 1.0, 'The Sales Distribution of Store # 14')
```



Observations:

```
* store number 14 has the maximum standard deviation  0.32 $M
```

In [31]:

```
#coefficient of mean to standard deviation
df_coeff_std =df.groupby('Store').agg({'Weekly_Sales':['mean','std']})
#df_coeff_std['Weekly_Sales']['mean']
#df_coeff_std.reset_index(inplace=True)
df_coeff_std['Coefficient of mean to standard deviation']= df_coeff_std['Weekly_Sales']['std']/df_coeff_std['Weekly_Sales']['mean']
#df_coeff_std[df_coeff_std['Coefficient of mean to standard deviation']==df_coeff_std['Coefficient of mean to standard deviation'].max()]


df_coeff_std.sort_values('Coefficient of mean to standard deviation', ascending=False)
```

Out[31]:

	Weekly_Sales		Coefficient of mean to standard deviation
	mean	std	
Store			
35	919,724.98	211,243.46	0.23
7	570,617.31	112,585.47	0.20
15	623,312.47	120,538.65	0.19
29	539,451.43	99,120.14	0.18
23	1,389,864.46	249,788.04	0.18
21	756,069.08	128,752.81	0.17
45	785,981.41	130,168.53	0.17
16	519,247.73	85,769.68	0.17
18	1,084,718.42	176,641.51	0.16
36	373,511.99	60,725.17	0.16
25	706,721.53	112,976.79	0.16
10	1,899,424.57	302,262.06	0.16
14	2,020,978.40	317,569.95	0.16
22	1,028,501.04	161,251.35	0.16
39	1,450,668.13	217,466.45	0.15
41	1,268,125.42	187,907.16	0.15
12	1,009,001.61	139,166.87	0.14
28	1,323,522.24	181,758.97	0.14
6	1,564,728.19	212,525.86	0.14
27	1,775,216.20	239,930.14	0.14
19	1,444,999.04	191,722.64	0.13
13	2,003,620.31	265,507.00	0.13
20	2,107,676.87	275,900.56	0.13
4	2,094,712.96	266,201.44	0.13
9	543,980.55	69,028.67	0.13
17	893,581.39	112,162.94	0.13
24	1,356,755.39	167,745.68	0.12
40	964,128.04	119,002.11	0.12
2	1,925,751.34	237,683.69	0.12
11	1,356,383.12	165,833.89	0.12
5	318,011.81	37,737.97	0.12
32	1,166,568.15	138,017.25	0.12
8	908,749.52	106,280.83	0.12

3	402,704.44	46,319.63	0.12
38	385,731.65	42,768.17	0.11
26	1,002,911.84	110,431.29	0.11
34	966,781.56	104,630.16	0.11
1	1,555,264.40	155,980.77	0.10
33	259,861.69	24,132.93	0.09
42	556,403.86	50,262.93	0.09
31	1,395,901.44	125,855.94	0.09
44	302,748.87	24,762.83	0.08
43	633,324.72	40,598.41	0.06
30	438,579.62	22,809.67	0.05
37	518,900.28	21,837.46	0.04

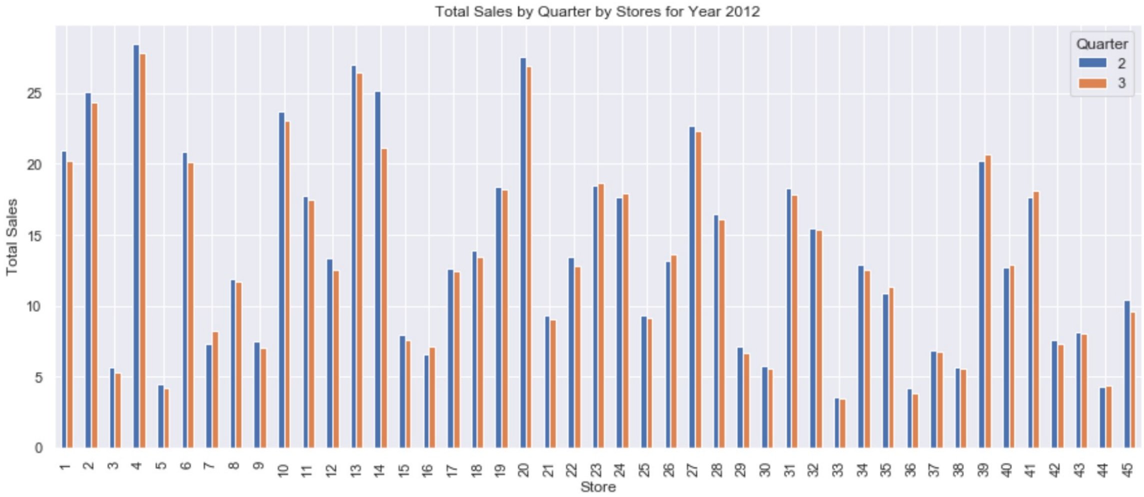
Observations:

```
* store number 35 has the maximum Coefficient of mean to standard deviatio
n : 0.23
```

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

In [32]:

```
df_Quarter =df.groupby(['Year','Quarter','Store'])[['Weekly_Sales
($M)']].sum().reset_index()

df_pvt=pd.pivot_table(df_Quarter[df_Quarter['Year']==2012], values='Wee
kly_Sales($M)', index='Store',columns=['Quarter'])
df_pvt
df_pvt[[2,3]].plot(kind='bar',figsize=(15,6))
plt.title('Total Sales by Quarter by Stores for Year 2012')
plt.ylabel('Total Sales')
plt.show()
```



In [33]:

```
df_Q32012 = df[(df['Year']==2012) & (df['Quarter']==3)]
df_Q32012_max=df_Q32012.groupby('Store').agg({'Weekly_Sales':['sum']})
df_Q32012_max[df_Q32012_max['Weekly_Sales']['sum']==df_Q32012_max['Week
ly_Sales']['sum'].max()]
```

Out[33]:

	Weekly_Sales
	sum
Store	
4	27,796,792.46

In [34]:

```
#top 10 total sales by store for 2012 3rd Quarter
df_Q32012.groupby('Store')[['Weekly_Sales']].sum().sort_values('Weekly_
Sales',ascending=False).head(10)
```

Out[34]:

	Weekly_Sales
Store	
4	27,796,792.46
20	26,891,526.98
13	26,421,259.30
2	24,303,354.86
10	23,037,258.76
27	22,307,711.41
14	21,187,560.65
39	20,715,116.23
1	20,253,947.78
6	20,167,312.24

Observations:¶

- Store Number 4 has Good Quartely Growth in Q3'2012: 27,796,792.46 compared to other Stores
- Store no 20 is 2nd in the list with good quaterly growth: 26,891,526.98

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 [35]:

```
df_Holiday = df[df['Holiday_Flag']==1]
df_Non_Holiday = df[df['Holiday_Flag']==0]
```

In [36]:

```
df_Holiday.groupby(['Holiday_category'])[['Weekly_Sales($M)']].mean().r
eset_index()
```

Out[36]:

	Holiday_category	Weekly_Sales($M)
0	Christmas	0.96
1	Labour Day	1.04
2	Super Bowl	1.08
3	Thanksgiving	1.47

In [37]:

```
df_Non_Holiday.groupby(['Holiday_category'])[['Weekly_Sales($M)']].mean
().reset_index()
```

Out[37]:

	Holiday_category	Weekly_Sales($M)
0	Non Holiday Week	1.04

Observations:

```
* Thanksgiving holiday season has higher sales than the mean sales in non-
holiday season for all stores together
```

In [38]:

```
#df_Holiday.groupby(['Holiday_category'])[['Weekly_Sales($M)']].mean().
reset_index().plot(kind='line', x='Holiday_category')
```

In [39]:

```
df_sales =df.groupby('date')[['Weekly_Sales($M)']].mean().reset_index()
df_sales.head()
```

Out[39]:

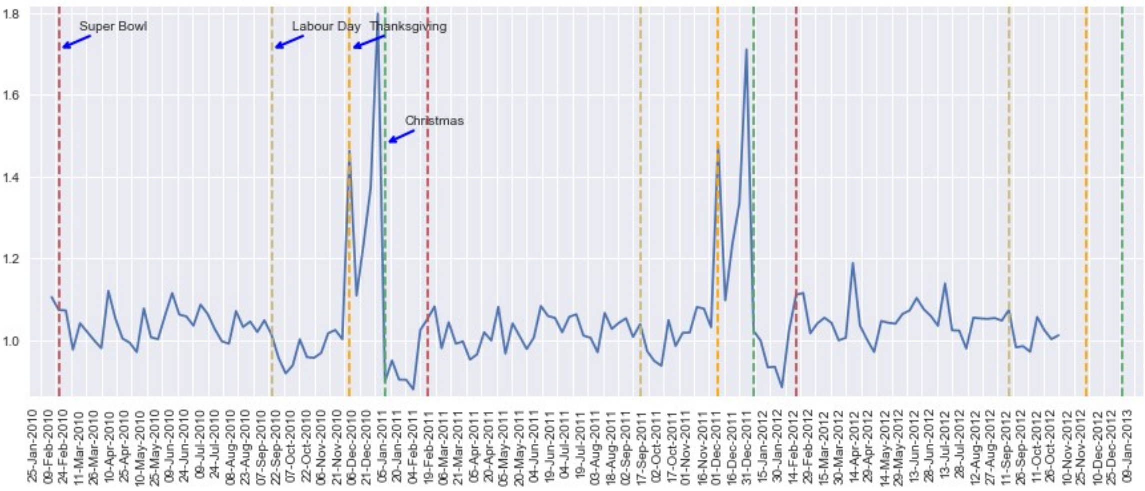
	date	Weekly_Sales($M)
0	2010-02-05	1.11
1	2010-02-12	1.07
2	2010-02-19	1.07
3	2010-02-26	0.98
4	2010-03-05	1.04

In [40]:

```
from datetime import datetime, timedelta
from matplotlib import pyplot as plt
from matplotlib import dates as mpl_dates

plt.style.use('seaborn')

fig, ax = plt.subplots(figsize = (15,6))


ax.plot(df_sales['date'],df_sales['Weekly_Sales($M)'])
plt.gcf().autofmt_xdate()
plt.gca().xaxis.set_major_formatter(mpl_dates.DateFormatter('%d-%b-%Y
'))
plt.gca().xaxis.set_major_locator(mpl_dates.DayLocator(interval=15))

plt.margins(0.02)

#super Bowl
ax.annotate('Super Bowl', (pd.to_datetime('12-2-2010',format='%d-%m-%Y
'), df_sales['Weekly_Sales($M)'][98]), xytext=(15, 15),
   textcoords='offset points', arrowprops=dict(arrowstyle='->',color='b
lue', lw=2))
fig.autofmt_xdate()


plt.axvline(x = pd.to_datetime('12-2-2010',format='%d-%m-%Y'), color =
'r', label = 'axvline - full height',linestyle='--')
plt.axvline(x = pd.to_datetime('11-2-2011',format='%d-%m-%Y'), color =
'r', label = 'axvline - full height',linestyle='--')
plt.axvline(x = pd.to_datetime('10-2-2012',format='%d-%m-%Y'), color =
'r', label = 'axvline - full height',linestyle='--')

#Labour Day
ax.annotate('Labour Day', (pd.to_datetime('10-9-2010',format='%d-%m-%Y
'), df_sales['Weekly_Sales($M)'][98]), xytext=(15, 15),
   textcoords='offset points', arrowprops=dict(arrowstyle='->',color='b
lue', lw=2))
fig.autofmt_xdate()

plt.axvline(x = pd.to_datetime('10-9-2010',format='%d-%m-%Y'), color =
'y', label = 'axvline - full height',linestyle='--')
plt.axvline(x = pd.to_datetime('9-9-2011',format='%d-%m-%Y'), color = '
y', label = 'axvline - full height',linestyle='--')
plt.axvline(x = pd.to_datetime('7-9-2012',format='%d-%m-%Y'), color = '
y', label = 'axvline - full height',linestyle='--')

#Thanksgiving
ax.annotate('Thanksgiving', (pd.to_datetime('26-11-2010',format='%d-%m
-%Y'), df_sales['Weekly_Sales($M)'][98]), xytext=(15, 15),
   textcoords='offset points', arrowprops=dict(arrowstyle='->',color='b
lue', lw=2))
fig.autofmt_xdate()

plt.axvline(x = pd.to_datetime('26-11-2010',format='%d-%m-%Y'), color =
'orange', label = 'axvline - full height',linestyle='--')
```

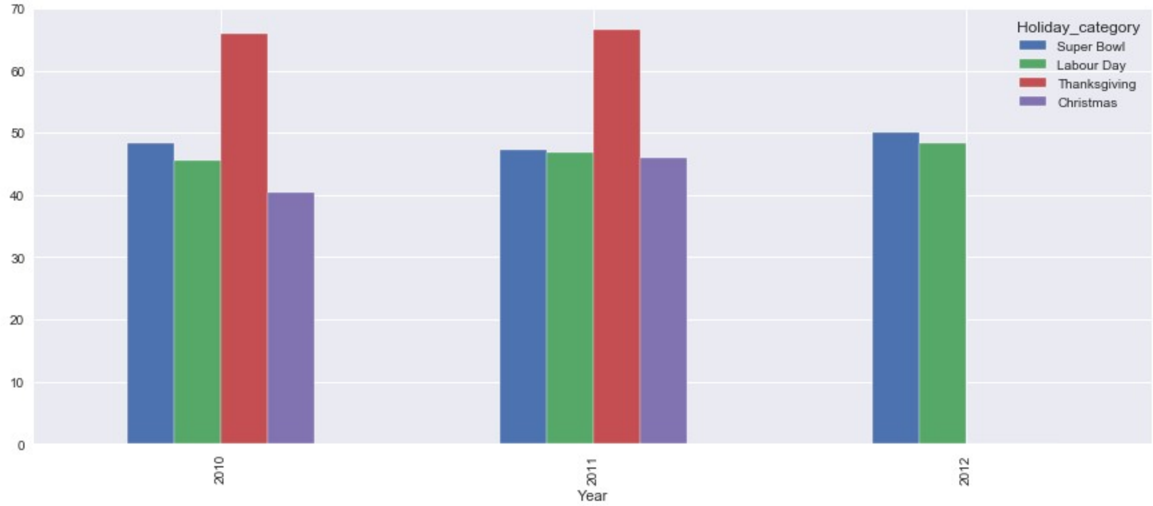
```
plt.axvline(x = pd.to_datetime('25-11-2011',format='%d-%m-%Y'), color =
'orange', label = 'axvline - full height',linestyle='--')
plt.axvline(x = pd.to_datetime('23-11-2012',format='%d-%m-%Y'), color =
'orange', label = 'axvline - full height',linestyle='--')

#Christmas
ax.annotate('Christmas', (pd.to_datetime('31-12-2010',format='%d-%m-%Y
'), df_sales['Weekly_Sales($M)'][94]), xytext=(15, 15),
   textcoords='offset points', arrowprops=dict(arrowstyle='->',color='b
lue', lw=2))
fig.autofmt_xdate()

plt.axvline(x = pd.to_datetime('31-12-2010',format='%d-%m-%Y'), color =
'g', label = 'axvline - full height',linestyle='--')
plt.axvline(x = pd.to_datetime('30-12-2011',format='%d-%m-%Y'), color =
'g', label = 'axvline - full height',linestyle='--')
plt.axvline(x = pd.to_datetime('28-12-2012',format='%d-%m-%Y'), color =
'g', label = 'axvline - full height',linestyle='--')

plt.xticks(rotation=90)
plt.show
```

```
Out[40]: <function matplotlib.pyplot.show(*args, **kw)>
```



In [41]:

```
# Sales by Year and holiday category


df_year_sales=df.groupby(['Year','Holiday_category'])[['Weekly_Sales
($M)']].sum().unstack().reset_index()

df_year_sales.columns=df_year_sales.columns.droplevel()

df_year_sales.rename(columns={'':'Year'},inplace=True)

#plotting

df_year_sales[['Year','Super Bowl','Labour Day','Thanksgiving','Christm
as']].plot(kind='bar', x='Year',figsize=(15,6))
plt.show()
```



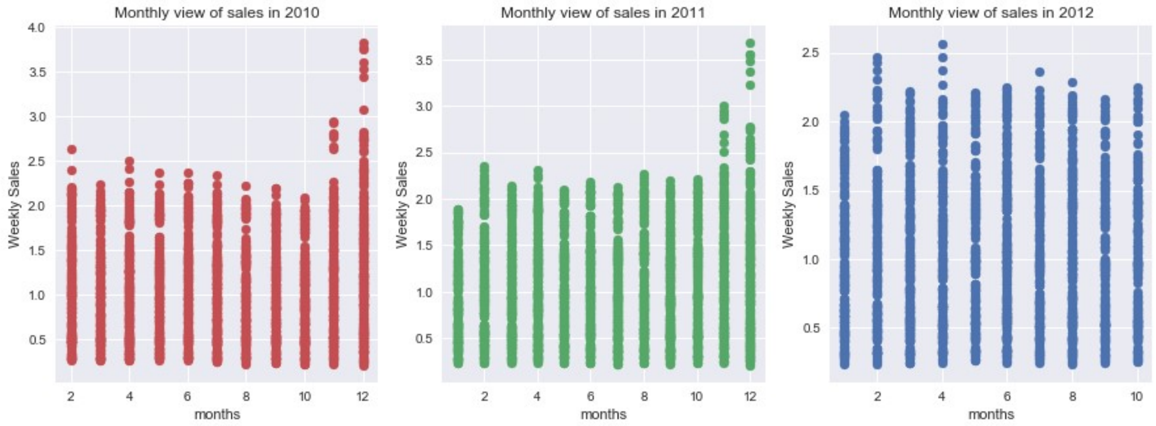
In [ ]:

Observations:

```
* The sales increased during thanksgiving. And the sales decreased during
christmas.
* No sales data for 2012 for Thanksgiving and Christmas in the given datas
et
```

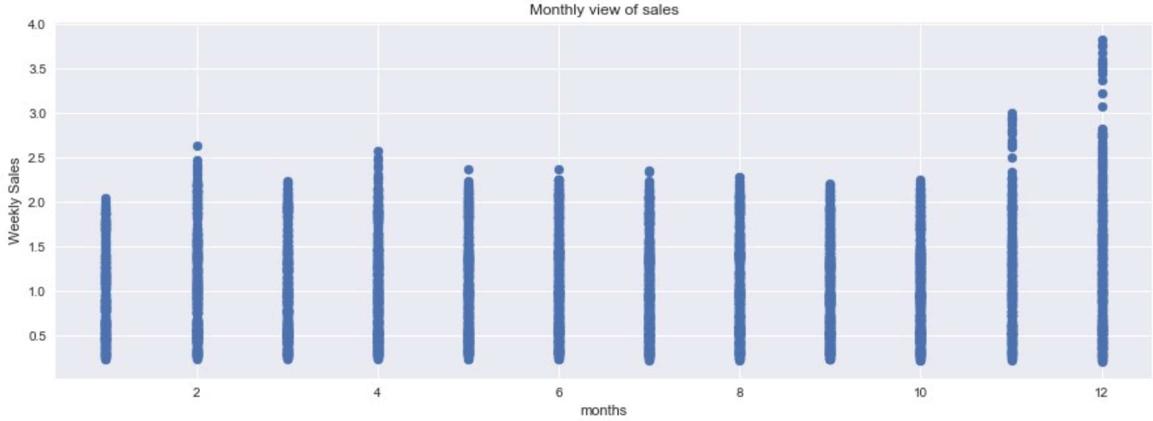
Provide a monthly and semester view of sales in units and give insights

In [42]:
```
# Monthly view of sales for each years
plt.figure(figsize=(15, 5))

plt.subplot(1, 3, 1)

plt.scatter(df[df.Year==2010]["Month"],df[df.Year==2010]["Weekly_Sales
($M)"], color='r')
plt.xlabel("months")
plt.ylabel("Weekly Sales")
plt.title("Monthly view of sales in 2010")


plt.subplot(1, 3, 2)

plt.scatter(df[df.Year==2011]["Month"],df[df.Year==2011]["Weekly_Sales
($M)"],color='g')
plt.xlabel("months")
plt.ylabel("Weekly Sales")
plt.title("Monthly view of sales in 2011")


plt.subplot(1, 3, 3)

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

plt.show()
```



In [43]:

```
# Monthly view of sales for each years
plt.figure(figsize=(15, 5))
plt.scatter(df["Month"],df["Weekly_Sales($M)"])
plt.xlabel("months")
plt.ylabel("Weekly Sales")
plt.title("Monthly view of sales")

plt.show()
```

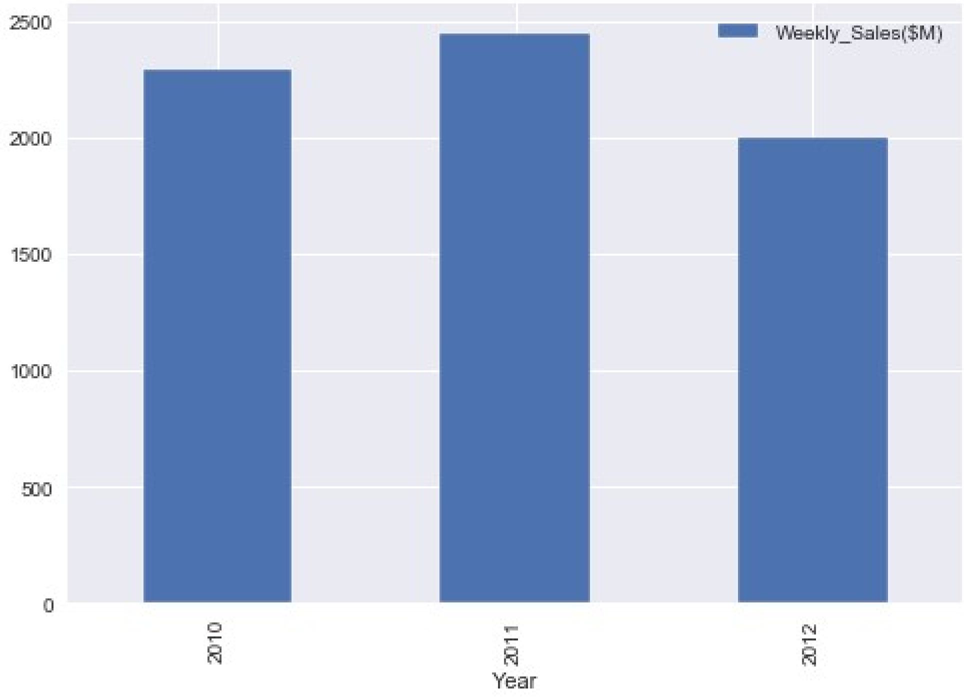


In [44]:

```
df.groupby(['Year'])[['Weekly_Sales($M)']].sum().plot(kind='bar')
```

Out[44]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1ee460567f0>
```



Change dates into days by creating new variable.

In [45]:

```
df["Day"]= pd.DatetimeIndex(df['date']).day
```

In [46]:

```
df_modelling = df[['Store','date','Weekly_Sales','Holiday_Flag','Temperature','Fuel_Price','CPI','Unemployment','Year','Month','Day']]
df_modelling.head()
```

Out[46]:

	Store	date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployn
0	1	2010-02-05	1,643,690.90	0	42.31	2.57	211.10	
1	1	2010-02-12	1,641,957.44	1	38.51	2.55	211.24	
2	1	2010-02-19	1,611,968.17	0	39.93	2.51	211.29	
3	1	2010-02-26	1,409,727.59	0	46.63	2.56	211.32	
4	1	2010-03-05	1,554,806.68	0	46.50	2.62	211.35	

Modelling and Forecasting Sales

In [51]:

```
#checking outliers
plt.figure(figsize=(15, 5))

plt.subplot(1, 4, 1)
sns.boxplot(df_modelling['Temperature'])

plt.subplot(1, 4, 2)
sns.boxplot(df_modelling['Fuel_Price'])

plt.subplot(1, 4, 3)
sns.boxplot(df_modelling['CPI'])

plt.subplot(1, 4, 4)
sns.boxplot(df_modelling['Unemployment'])

plt.show()
```

```
C:\Users\SujitSonar\Anaconda3\lib\site-packages\seaborn\_decorators.p
y:43: FutureWarning: Pass the following variable as a keyword arg: x.
From version 0.12, the only valid positional argument will be `data`,
and passing other arguments without an explicit keyword will result i
n an error or misinterpretation.
  FutureWarning
C:\Users\SujitSonar\Anaconda3\lib\site-packages\seaborn\_decorators.p
y:43: FutureWarning: Pass the following variable as a keyword arg: x.
From version 0.12, the only valid positional argument will be `data`,
and passing other arguments without an explicit keyword will result i
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  FutureWarning
C:\Users\SujitSonar\Anaconda3\lib\site-packages\seaborn\_decorators.p
y:43: FutureWarning: Pass the following variable as a keyword arg: x.
From version 0.12, the only valid positional argument will be `data`,
and passing other arguments without an explicit keyword will result i
n an error or misinterpretation.
  FutureWarning
C:\Users\SujitSonar\Anaconda3\lib\site-packages\seaborn\_decorators.p
y:43: FutureWarning: Pass the following variable as a keyword arg: x.
From version 0.12, the only valid positional argument will be `data`,
and passing other arguments without an explicit keyword will result i
n an error or misinterpretation.
  FutureWarning
```
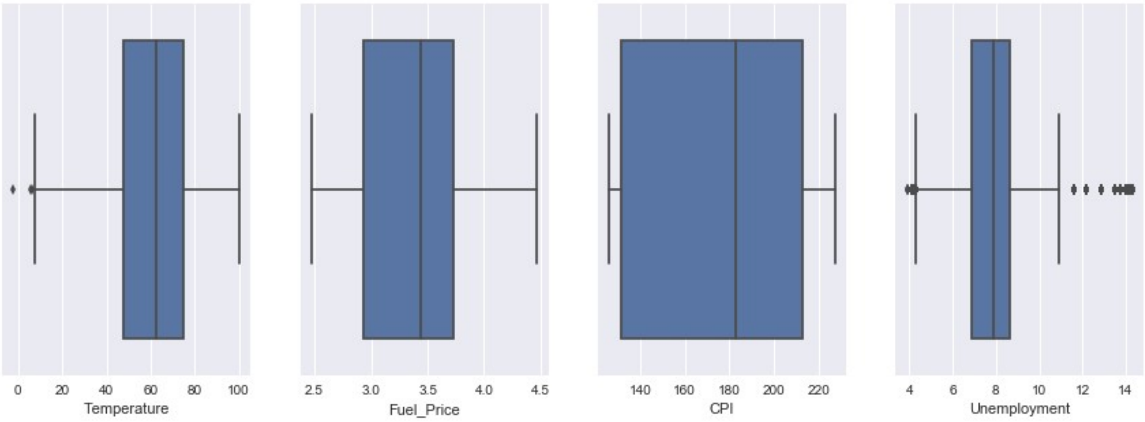



In [52]:
```
df_modelling['Temperature'].describe()
```

Out[52]:
```
count   6,435.00
mean       60.66
std        18.44
min        -2.06
25%        47.46
50%        62.67
75%        74.94
max       100.14
Name: Temperature, dtype: float64
```

In [53]:
```
df_modelling['Unemployment'].describe()
```

Out[53]:
```
count   6,435.00
mean        8.00
std         1.88
min         3.88
25%         6.89
50%         7.87
75%         8.62
max        14.31
Name: Unemployment, dtype: float64
```

Observations:

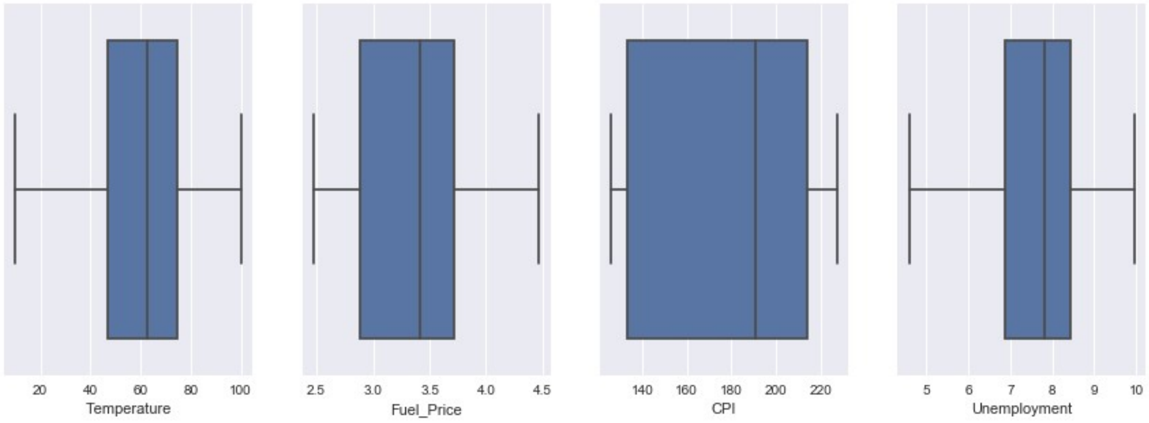
```
* we see there are few ouliers in Temperature (<10) and Unemployment (<4.5
and >10)
```

In [55]:
```
# dropping rows where Temperature (<10) and Unemployment (<4.5 and >10)

df_modelling_new = df_modelling[(df_modelling['Unemployment']<10) & (df
_modelling['Unemployment']>4.5) & (df_modelling['Temperature']>10)]
```

In [57]:
```
plt.figure(figsize=(15, 5))

plt.subplot(1, 4, 1)
sns.boxplot(df_modelling_new['Temperature'])

plt.subplot(1, 4, 2)
sns.boxplot(df_modelling_new['Fuel_Price'])

plt.subplot(1, 4, 3)
sns.boxplot(df_modelling_new['CPI'])

plt.subplot(1, 4, 4)
sns.boxplot(df_modelling_new['Unemployment'])
```

```
C:\Users\SujitSonar\Anaconda3\lib\site-packages\seaborn\_decorators.p
y:43: FutureWarning: Pass the following variable as a keyword arg: x.
From version 0.12, the only valid positional argument will be `data`,
and passing other arguments without an explicit keyword will result i
n an error or misinterpretation.
  FutureWarning
C:\Users\SujitSonar\Anaconda3\lib\site-packages\seaborn\_decorators.p
y:43: FutureWarning: Pass the following variable as a keyword arg: x.
From version 0.12, the only valid positional argument will be `data`,
and passing other arguments without an explicit keyword will result i
n an error or misinterpretation.
  FutureWarning
C:\Users\SujitSonar\Anaconda3\lib\site-packages\seaborn\_decorators.p
y:43: FutureWarning: Pass the following variable as a keyword arg: x.
From version 0.12, the only valid positional argument will be `data`,
and passing other arguments without an explicit keyword will result i
n an error or misinterpretation.
  FutureWarning
C:\Users\SujitSonar\Anaconda3\lib\site-packages\seaborn\_decorators.p
y:43: FutureWarning: Pass the following variable as a keyword arg: x.
From version 0.12, the only valid positional argument will be `data`,
and passing other arguments without an explicit keyword will result i
n an error or misinterpretation.
  FutureWarning
```

Out[57]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1ee455d7b00>
```



Building a Model

In [58]:

```
# 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 [59]:

```
df_modelling_new.head(2)
```

Out[59]:

	Store	date	Weekly_Sales	Holiday_Flag	Temperature	Fuel_Price	CPI	Unemployn
0	1	2010-02-05	1,643,690.90	0	42.31	2.57	211.10	
1	1	2010-02-12	1,641,957.44	1	38.51	2.55	211.24	

In [66]:

```
df_modelling_new[['Weekly_Sales','Temperature','Fuel_Price','CPI','Unem
ployment','Day','Month','Year']].corr()
```

Out[66]:

	Weekly_Sales	Temperature	Fuel_Price	CPI	Unemployment	Day	Month	Y
Weekly_Sales	1.00	-0.06	0.00	-0.09	-0.01	-0.02	0.08	-(
Temperature	-0.06	1.00	0.13	0.23	-0.00	0.03	0.24	(
Fuel_Price	0.00	0.13	1.00	-0.14	-0.12	0.03	-0.04	(
CPI	-0.09	0.23	-0.14	1.00	-0.21	0.00	0.01	(
Unemployment	-0.01	-0.00	-0.12	-0.21	1.00	-0.00	-0.02	-(
Day	-0.02	0.03	0.03	0.00	-0.00	1.00	0.01	(
Month	0.08	0.24	-0.04	0.01	-0.02	0.01	1.00	-(
Year	-0.05	0.07	0.78	0.09	-0.27	0.01	-0.19	1

Observations:

```
* we see Fuel price does not have any corelation with Weekly sales
* Month has some corelation and perhaps this is due to holiday seasons in
certain months of the year
* Other featues seems to be very negatively corelated but then ,Corelation
s does not give us much information
```

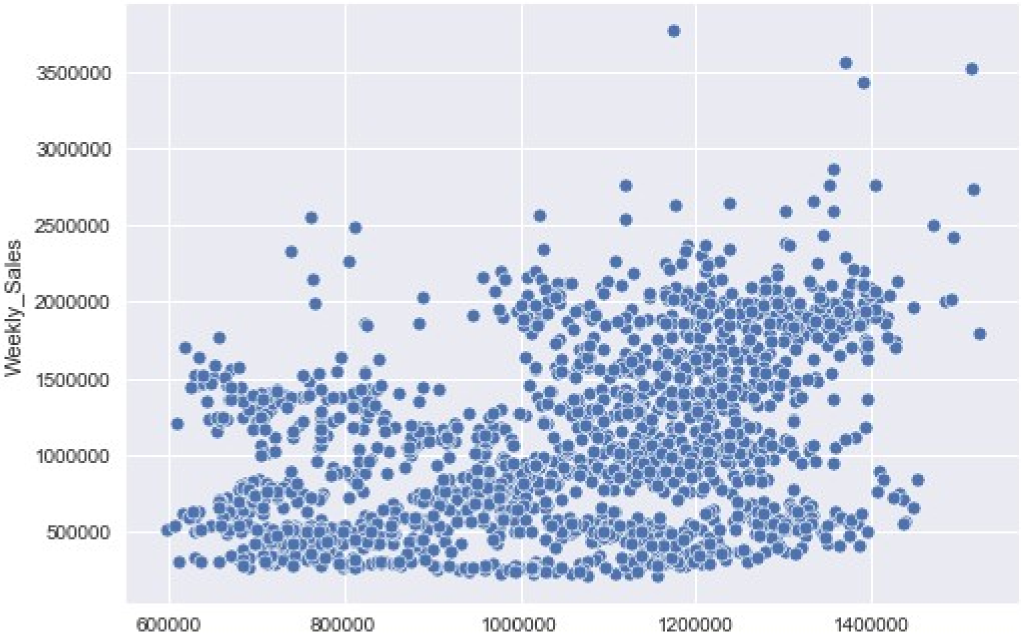
In [67]:

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

# Split data to train and test (0.70:0.30)
X_train, X_test, y_train, y_test = train_test_split(X,y,test_size=0.3)
```

In [68]:

```
# 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_pre
d))
print('Mean Squared Error:', metrics.mean_squared_error(y_test, y_pre
d))
print('Root Mean Squared Error:', np.sqrt(metrics.mean_squared_error(y_
test, y_pred)))


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

```
Linear Regression:

Accuracy: 13.412820643570633
Mean Absolute Error: 456155.73393569974
Mean Squared Error: 301682244459.7772
Root Mean Squared Error: 549256.0827699382

C:\Users\SujitSonar\Anaconda3\lib\site-packages\seaborn\_decorators.p
y:43: FutureWarning: Pass the following variables as keyword args: x,
y. From version 0.12, the only valid positional argument will be `dat
a`, and passing other arguments without an explicit keyword will resu
lt in an error or misinterpretation.
  FutureWarning
```

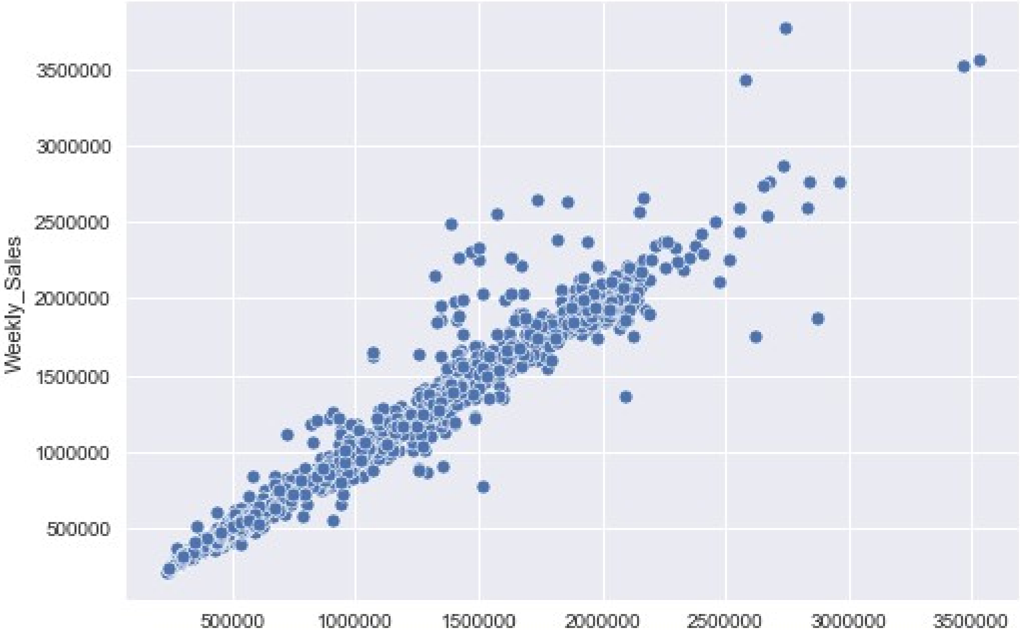


Observations:

- Accuracy is very small with Linear Regression model, aound 13%

```
In [69]: # 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_pre
         d))
         print('Mean Squared Error:', metrics.mean_squared_error(y_test, y_pre
         d))
         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: 95.55558116088143
Mean Absolute Error: 60791.15738384984
Mean Squared Error: 15407599735.024164
Root Mean Squared Error: 124127.35288816951

C:\Users\SujitSonar\Anaconda3\lib\site-packages\seaborn\_decorators.p
y:43: FutureWarning: Pass the following variables as keyword args: x,
y. From version 0.12, the only valid positional argument will be `dat
a`, and passing other arguments without an explicit keyword will resu
lt in an error or misinterpretation.
  FutureWarning
```



In [89]:

```
s1 = pd.DataFrame(y_pred[0:10],y_test.values[0:10]).reset_index()
names =['y_test','y_pred']
s1.columns = names
s1
```

Out[89]:

	y_test	y_pred
0	1,999,794.26	2,093,792.16
1	1,882,070.88	1,997,338.28
2	1,605,491.78	1,544,298.32
3	1,397,970.54	1,372,428.63
4	479,263.15	516,139.10
5	276,157.80	283,865.73
6	597,406.39	603,771.81
7	733,037.32	751,133.00
8	583,079.97	574,376.85
9	1,306,644.25	1,342,381.42

Observations:

```
* Random Forest regressor model has a much better accuracy: around 96%
```

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]: