Computing and Data Science

2th Year

Dr. Amira Youssef

Team of project

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ABSTRACT

Retail analysis with Walmart

The aim of this project is enable category managers of Walmart to check the weekly and monthly sales of the departments. Analysis includes the effect of markdowns on the sales and the extent of effect on the sales by fuel prices, temperature, unemployment, CPI etc. Has been analyzed using simple and multiple linear regression models.

Dataset Description

Walmart runs several promotional markdown events throughout the year. These markdowns precede prominent holidays, the four largest of all, which are the Super Bowl, Labour Day, Thanksgiving, and Christmas. The weeks including these holidays are weighted five times higher in the evaluation than non-holiday weeks. Part of the challenge presented by this assignment is modeling the effects of markdowns on these holiday weeks in the absence of complete/ideal historical data. Historical sales data for 45 Walmart stores located in different regions are available.

Why to Perform exploratory data analysis?

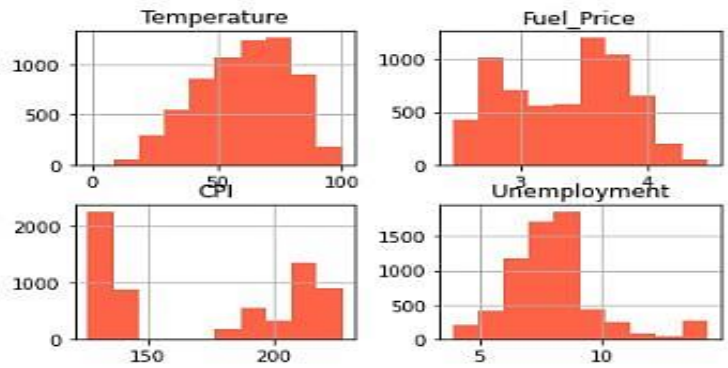
Exploratory Data Analysis is a data analytics process to understand the data in depth and learn the different data characteristics, often with visual means. This allows you to get a better feel of your data and find useful patterns in it.

visualize quantitive variables distributions

- **benefits of visualize**
  - Data visualization allows business users to gain insight into their vast amounts of data. It benefits them to recognize new patterns and errors in the data. Making sense of these patterns helps the users pay attention to areas that indicate red flags or progress. This process, in turn, drives the business ahead.

c) visualize quantitive variables distributions

```
In [32]: new_data = df[["Temperature", "Fuel_Price", "CPI", "Unemployment"]]

In [33]: plt.figure(figsize = (10, 7))
         new_data.hist(color="tomato")

Out[33]: array([[<AxesSubplot:title={'center':'Temperature'}>,
                 <AxesSubplot:title={'center':'Fuel_Price'}>],
                [<AxesSubplot:title={'center':'CPI'}>,
                 <AxesSubplot:title={'center':'Unemployment'}>]], dtype=object)

         <Figure size 720x504 with 0 Axes>
```



Why to Perform data cleaning?

Data cleaning refers to the process of removing unwanted variables and values from your dataset and getting rid of any irregularities in it. Such anomalies can disproportionately skew the data and hence adversely affect the results.

- **STEPS:**
  - **1)** We use method: **.isnull().sum()**
    To know if there is a null value in data or no
  - **2)** we use method: . duplicated()
    To know if there is duplicate in data or no

- And use the .info() & .describe().T : to learn more about data

d) perform data cleaning

```
In [4]: df.info()#we check if we have any null value but we don't have it
```

```
<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 [4]: # Descriptive Statistics
        df.describe().T
```

Out[4]:

	count	mean	std	min	25%	50%	75%	max
Store	6435.0	2.300000e+01	12.988182	1.000	12.000	23.000000	3.400000e+01	4.500000e+01
Weekly_Sales	6435.0	1.046965e+06	564366.622054	209986.250	553350.105	960746.040000	1.420159e+06	3.818686e+06
Holiday_Flag	6435.0	6.993007e-02	0.255049	0.000	0.000	0.000000	0.000000e+00	1.000000e+00
Temperature	6435.0	6.066378e+01	18.444933	-2.060	47.460	62.670000	7.494000e+01	1.001400e+02
Fuel_Price	6435.0	3.358607e+00	0.459020	2.472	2.933	3.445000	3.735000e+00	4.468000e+00
CPI	6435.0	1.715784e+02	39.356712	126.064	131.735	182.616521	2.127433e+02	2.272328e+02
Unemployment	6435.0	7.999151e+00	1.875885	3.879	6.891	7.874000	8.622000e+00	1.431300e+01

- To know if there is duplicate in data or no & there is a null value in this data or no

```
In [5]: df.isnull().sum()
```

```
Out[5]: Store          0
        Date           0
        Weekly_Sales   0
        Holiday_Flag   0
        Temperature    0
        Fuel_Price     0
        CPI            0
        Unemployment   0
        dtype: int64
```

```
In [30]: #check duplicated
         df.duplicated() ##no any duplicate in data
```

```
Out[30]: 0       False
         1       False
         2       False
         3       False
         4       False
                 ...
         6430    False
         6431    False
         6432    False
         6433    False
         6434    False
         Length: 6435, dtype: bool
```

```
In [31]: df.Date = pd.to_datetime(df.Date) ##to convert the date into date form
```

```
In [7]: #seprate month and year from data frame
        df['Month']=df['Date'].dt.month
        df['Year']=df['Date'].dt.year
        df['Day']=df['Date'].dt.day

        df
```

Out[7]:

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

6435 rows × 11 columns

A) Which store has maximum sales?

a) Which store has maximum sales?

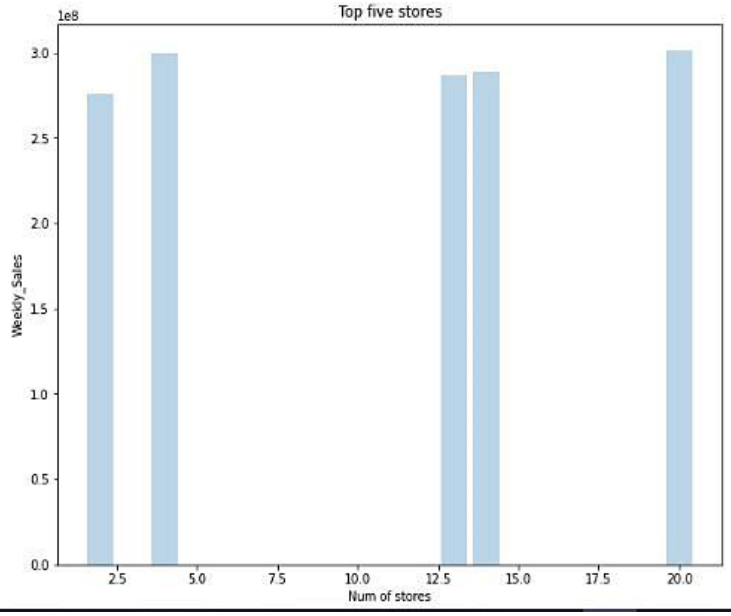
```
In [35]: max_store_with_largest_store=df.groupby('Store')['Weekly_Sales'].sum().idxmax()#name of store
         max_store_with_largest_sales=df.groupby('Store')['Weekly_Sales'].sum().max()#max of sales
         print('the store which has max sales is {} and weekly sales for store is: {}$ '
               .format(max_store_with_largest_store,max_store_with_largest_sales))
         ####Store-20 has the maximum sales of $301,397,79
```

```
the store which has max sales is 20 and weekly sales for store is: 301397792.46$
```

- **The comment:**

  Store Number 20 has maximum Sales more than other stores

```
In [37]: #we have top 5 store
         x=df.groupby('Store')['Weekly_Sales'].sum().round().sort_values(ascending=False).head().to_frame().reset_index()
         plt.figure(figsize=(10,8))
         plt.bar(x['Store'],x['Weekly_Sales'],alpha=.3)
         plt.title('Top five stores')
         plt.xlabel('Num of stores')
         plt.ylabel('Weekly_Sales')
         plt.show()
```



- **The comment:**

  The high of five store

B) Which store has maximum standard deviation i.e., the sales vary a lot?

b) Which store has maximum standard deviation i.e., the sales vary a lot

```
In [38]: max_store_with_largest_store=df.groupby('Store')['Weekly_Sales'].std().idxmax()
         max_store_with_largest_sales=df.groupby('Store')['Weekly_Sales'].std().max()
         print('the store which has max STD is {} and STD is: {} '.format(max_store_with_largest_store,max_store_with_largest_sales))

         the store which has max STD is 14 and STD is: 317569.9494755081
```

- **The comment:**

  The store has max std is 14 equal 317569.9494

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

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

```
In [39]: ##info about holiday
         Super_Bowl = ['12-2-2010', '11-2-2011', '10-2-2012'] ##data of holidays
         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']


         # Calculating holiday events sales
         Super_Bowl_sales = round(df.loc[df.Date.isin(Super_Bowl)]['Weekly_Sales'].mean(),2)
         Labour_Day_sales = round(df.loc[df.Date.isin(Labour_Day)]['Weekly_Sales'].mean(),2)
         Thanksgiving_sales = round(df.loc[df.Date.isin(Thanksgiving)]['Weekly_Sales'].mean(),2)
         Christmas_sales = round(df.loc[df.Date.isin(Christmas)]['Weekly_Sales'].mean(),2)
         Super_Bowl_sales, Labour_Day_sales, Thanksgiving_sales, Christmas_sales

Out[39]: (1079127.99, 1042427.29, 1471273.43, 960833.11)
```

- **The comment:**

  Enter the data of holiday and calculate the week sales of this days of holiday

```
In [40]: #non holiday
         non_holiday_sales = round(df.query('Holiday_Flag == 0')['Weekly_Sales'].mean(),2)
         non_holiday_sales

Out[40]: 1041256.38
```

- **The comment:**

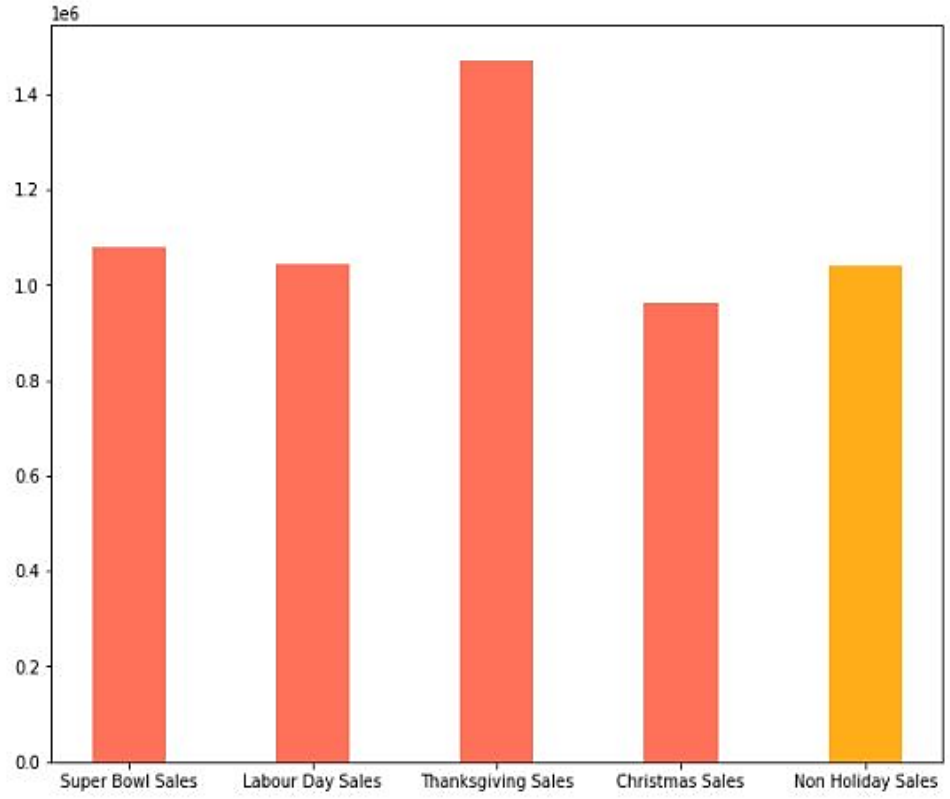
  Enter the non-holiday and calculate the week sales of this days

```
In [42]: result = {'Super Bowl Sales':Super_Bowl_sales,  ##input this data as dictionary
                   'Labour Day Sales':Labour_Day_sales,
                   'Thanksgiving Sales':Thanksgiving_sales,
                   'Christmas Sales':Christmas_sales,
                   'Non Holiday Sales':non_holiday_sales}

         result

Out[42]: {'Super Bowl Sales': 1079127.99,
          'Labour Day Sales': 1042427.29,
          'Thanksgiving Sales': 1471273.43,
          'Christmas Sales': 960833.11,
          'Non Holiday Sales': 1041256.38}

In [43]: for i in result:     ##to know which holiday is higher than non_holiday
             if(result[i]>non_holiday_sales):
                 print('{} higher than the mean sales in the non-holiday season'.format(i))

         Super Bowl Sales higher than the mean sales in the non-holiday season
         Labour Day Sales higher than the mean sales in the non-holiday season
         Thanksgiving Sales higher than the mean sales in the non-holiday season
```

- **The comment:**

  Enter the pre-data into dictionary and make for loop to know which holiday has more mean of week sales than mean of week sales from non-holiday

```
In [45]: c=['tomato','tomato','tomato','tomato','orange']
         plt.figure(figsize=(10,8))
         plt.bar(result.keys(), result.values(), color =c,width = 0.4,alpha=0.9);
```



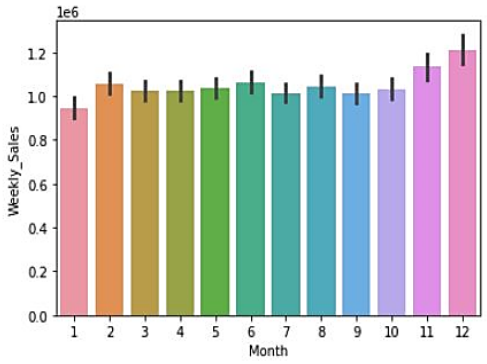
- **<u>The comment:</u>**

  I found that Thanksgiving has the highest sales ($1,471,273.43) than non-holiday sales ($1,041,256.38).

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

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

In [65]:
```
# monthly view of sales
sns.barplot(data=df,x='Month',y='Weekly_Sales');
```



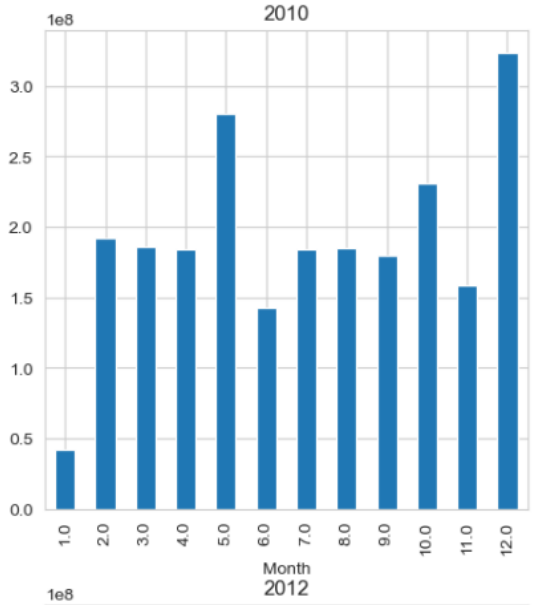
- **The comment:**
  - I found that: December month has the highest weekly sales

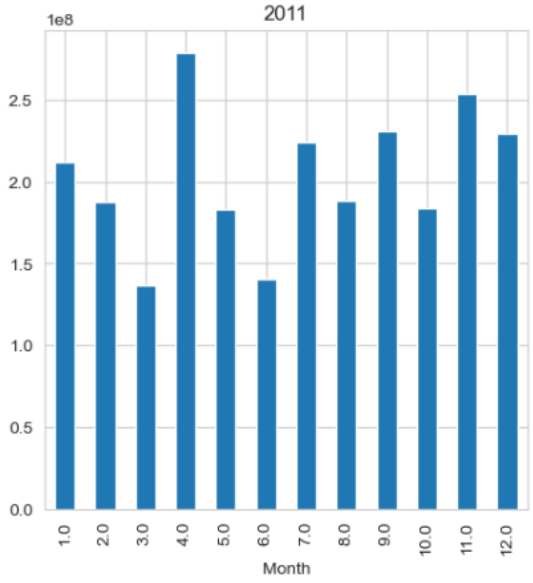
Monthly view of sales for each years

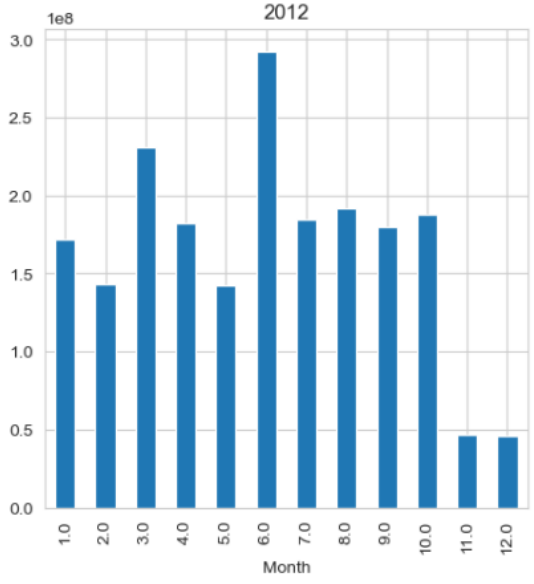
```
fig = plt.figure(figsize=(11,11))
ax=plt.subplot2grid((2,2),(0,0))
x=df[df.Year==2010]["Month"]
df.groupby(x)['Weekly_Sales'].sum().round().plot(kind='bar',legend=False);
plt.title('2010')

ax=plt.subplot2grid((2,2),(0,1))
y=df[df.Year==2011]["Month"]
df.groupby(y)['Weekly_Sales'].sum().round().plot(kind='bar',legend=False);
plt.title('2011')

ax=plt.subplot2grid((2,2),(1,0))
z=df[df.Year==2012]["Month"]
df.groupby(z)['Weekly_Sales'].sum().round().plot(kind='bar',legend=False);
plt.title('2012')
```

Output:

- **The comment:**
  - I found that: December month has the highest weekly sales in year of 2010
  - I found that: April month has the highest weekly sales in year of 2011
  - I found that: June month has the highest weekly sales in year of 2012





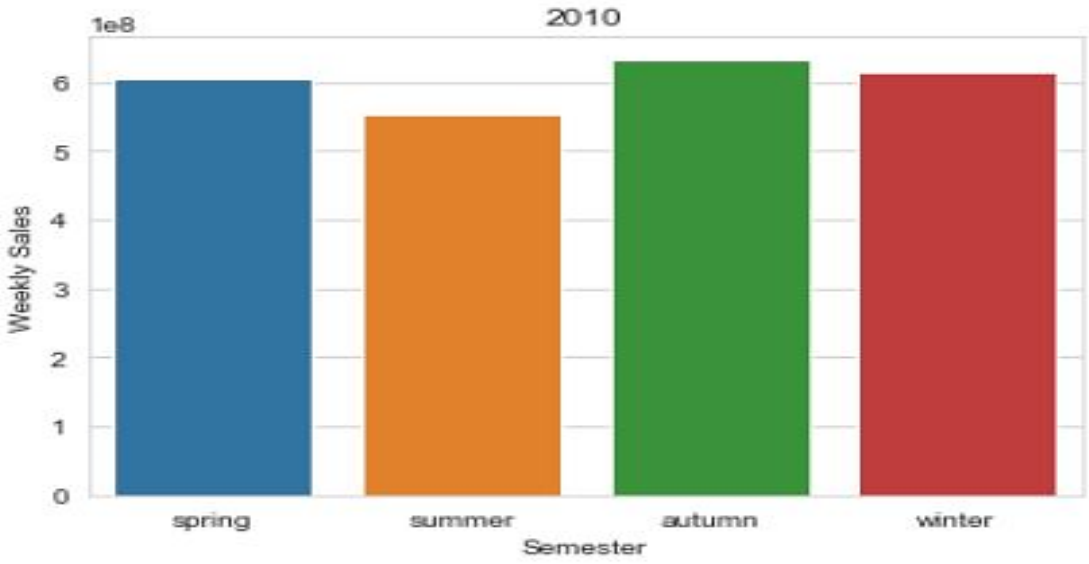


1)Semester in every year:

In 2010

```
In [48]: # 2010 semesters
         dx=df.set_index('Date').sort_values('Date')
         spring=dx.loc['2010-03-20':'2010-06-20'].Weekly_Sales.sum()
         summer=dx.loc['2010-06-21':'2010-09-22'].Weekly_Sales.sum()
         autumn=dx.loc['2010-09-23':'2010-12-21'].Weekly_Sales.sum()
         winter=dx.loc['2010-12-22':'2011-03-20'].Weekly_Sales.sum()

         dxx=pd.DataFrame({"spring":spring,
                           "summer":summer,
                           "autumn":autumn,
                           "winter":winter},index=[0])
         sns.set_style("whitegrid")
         sns.barplot(data=dxx).set(xlabel ="Semester", ylabel = "Weekly Sales", title ='2010');
```

Output:

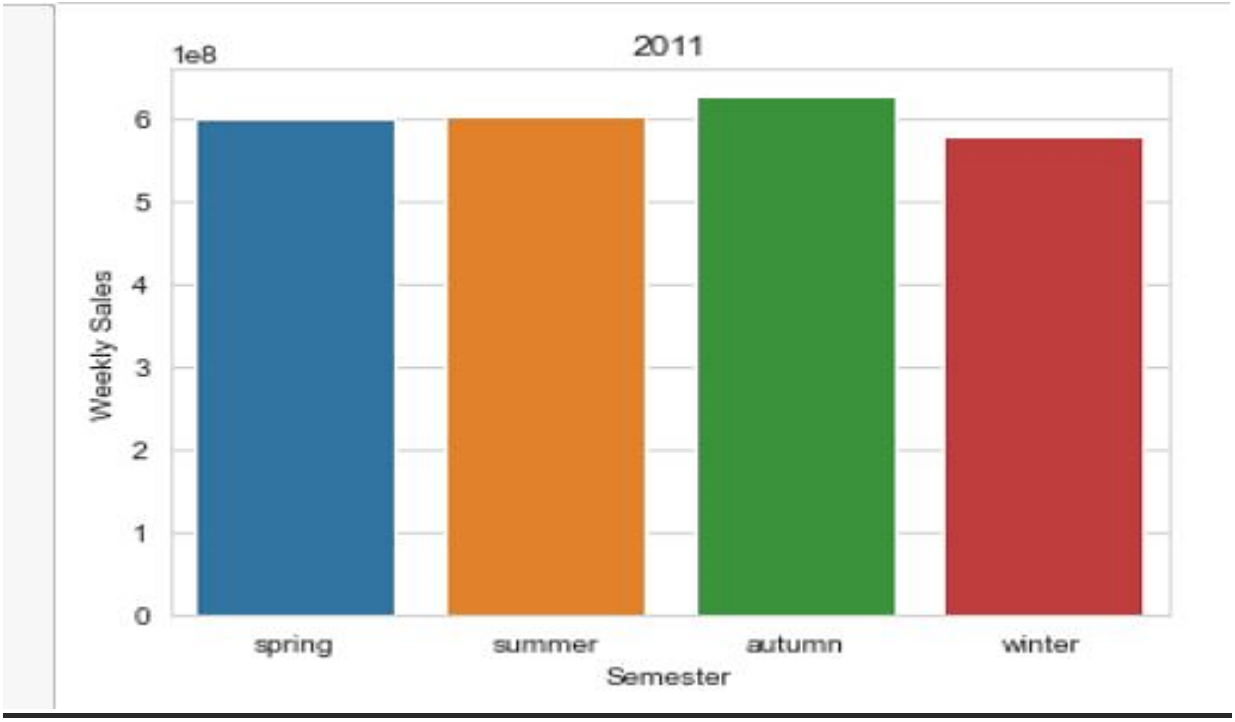


- **The comment:**
  - I found that: autumn semester has the highest weekly sales in year of 2010

1) 2011

```
In [49]: # 2011 semesters
dx=df.set_index('Date').sort_values('Date')
spring=dx.loc['2011-03-21':'2011-06-20'].Weekly_Sales.sum()
summer=dx.loc['2011-06-21':'2011-09-22'].Weekly_Sales.sum()
autumn=dx.loc['2011-09-23':'2011-12-21'].Weekly_Sales.sum()
winter=dx.loc['2011-12-22':'2012-03-20'].Weekly_Sales.sum()

dxx=pd.DataFrame({"spring":spring,
                  "summer":summer,
                  "autumn":autumn,
                  "winter":winter},index=[0])
sns.set_style("whitegrid")
sns.barplot(data=dxx).set(xlabel ="Semester", ylabel = "Weekly Sales", title ='2011');
```

Output:

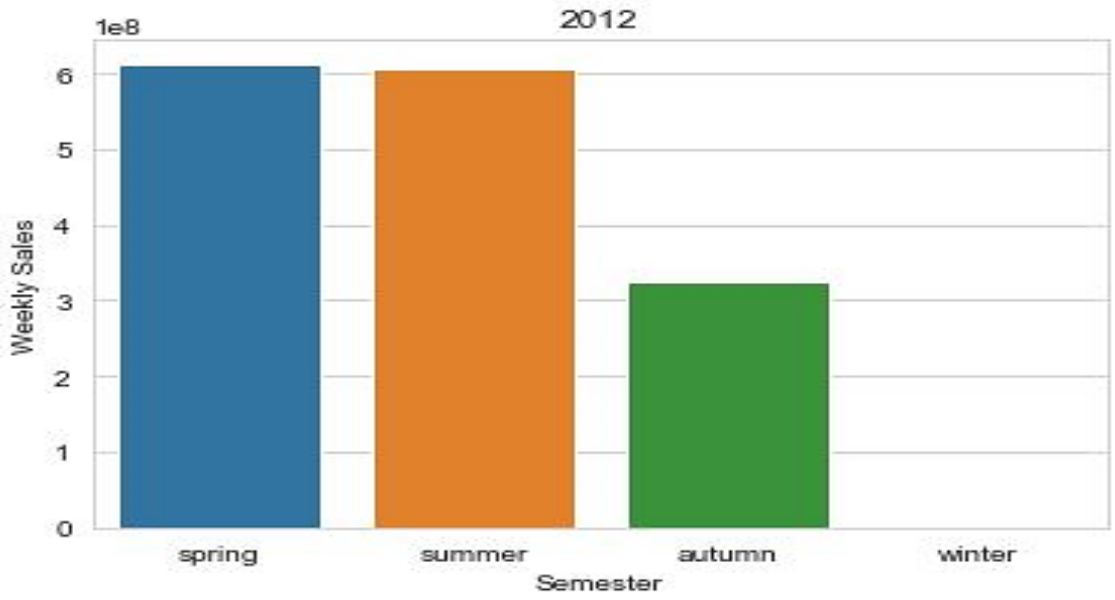


- **The comment:**
  - I found that: autumn semester has the highest weekly sales in year of 2011

2) 2012

In [50]:
```
# 2012 semesters
dx=df.set_index('Date').sort_values('Date')
spring=dx.loc['2012-03-20':'2012-06-20'].Weekly_Sales.sum()
summer=dx.loc['2012-06-21':'2012-09-21'].Weekly_Sales.sum()
autumn=dx.loc['2012-09-22':'2012-12-20'].Weekly_Sales.sum()
winter=dx.loc['2012-12-21':'2013-03-19'].Weekly_Sales.sum()

dxx=pd.DataFrame({"spring":spring,
                  "summer":summer,
                  "autumn":autumn,
                  "winter":winter},index=[0])
sns.set_style("whitegrid")
sns.barplot(data=dxx).set(xlabel ="Semester", ylabel = "Weekly Sales", title ='2012');
```

Output:

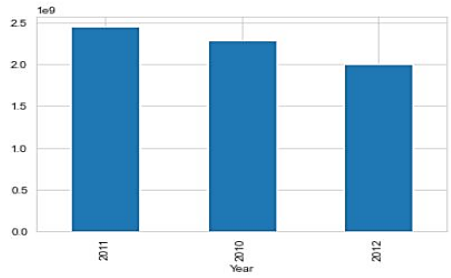


- **The comment:**
  - I found that: spring semester has the highest weekly sales in year of 2012

e) Plot the relations between weekly sales vs. other numeric features and give insights.

1)Plot the relations between weekly sales vs years

```
In [74]: # yearly view of sales
df.groupby('Year')['Weekly_Sales'].sum().round().sort_values(ascending=False).to_frame().plot(kind='bar',legend=False);
```

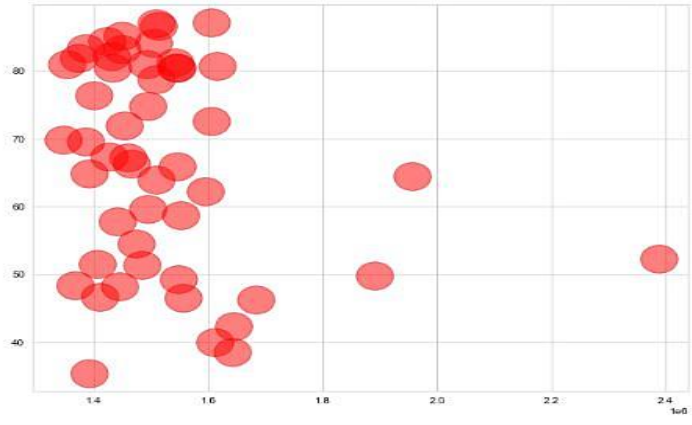


- **The comment:**
  - I found that: Year 2011 has the highest weekly sales.

2)Plot the relations between weekly sales vs temperature

e) Plot the relations between weekly sales vs. other numeric features and give insights.

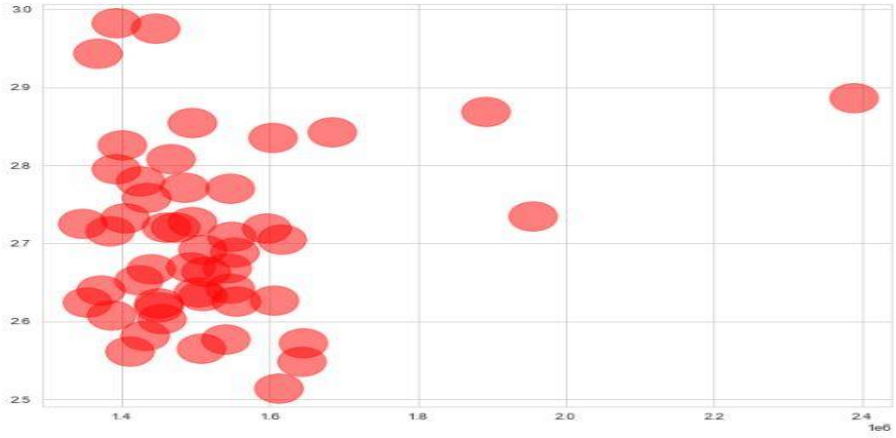
```
In [75]: z = np.random.rand(150)
plt.figure(figsize=(10, 8))
plt.scatter(df['Weekly_Sales'].head(50),df['Temperature'].head(50),color='red',s= 1000, alpha=0.5);
```



- **The comment:**
  - I found that: when the Temperature is 80 or above ..> the weekly sales is high
  - I found that: when the Temperature is [50 : 60] ..> the weekly sales is low

3)Plot the relations between weekly sales vs fuel_price

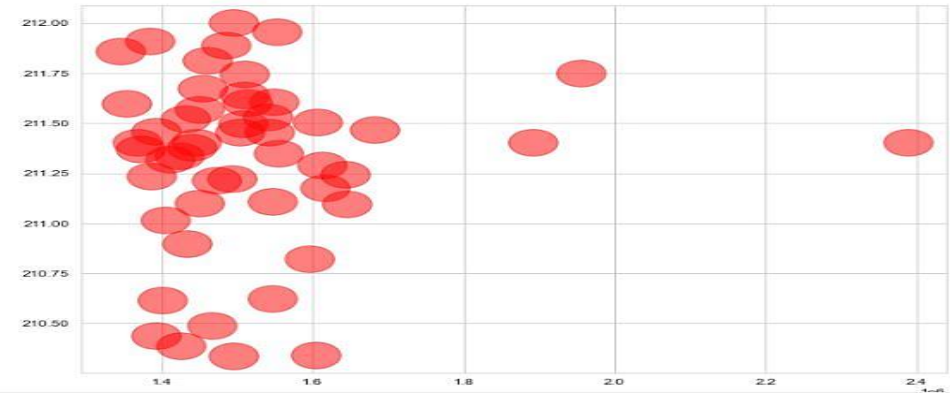
```
In [76]: z = np.random.rand(150)
         plt.figure(figsize=(10, 8))
         plt.scatter(df['Weekly_Sales'].head(50),df['Fuel_Price'].head(50),color='red',s= 1000, alpha=0.5);
```



- **The comment:**
  - I found that when fuel_price is increased, the weekly sales is decreased

4)Plot the relations between weekly sales vs CPI

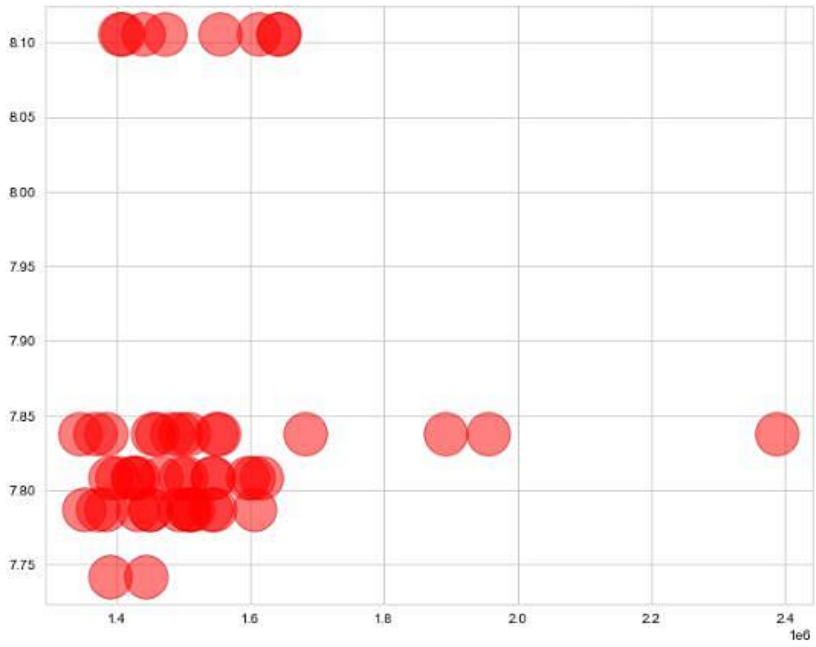
```
In [72]: z = np.random.rand(150)
         plt.figure(figsize=(10, 8))
         plt.scatter(df['Weekly_Sales'].head(50),df['CPI'].head(50),color='red',s= 1000, alpha=0.5);
```



- **The comment:**
  - I found that when CPI is increased , the weekly sales is increased

5)Plot the relations between weekly sales vs unemployment

```
In [73]: z = np.random.rand(150)
         plt.figure(figsize=(10, 8))
         plt.scatter(df['Weekly_Sales'].head(50),df['Unemployment'].head(50),color='red',s= 1000, alpha=0.5);
```



- **The comment:**
  - I found that when Unemployment is increased, the weekly sales is decreased