In [1]:

```
#importing the package
import pandas as pd #for data frame
import numpy as np #maths
import matplotlib.pyplot as plt #graph
import seaborn as sns #graph
# import re
import time #time and date
# from collections import Counter
import itertools
from statsmodels.tsa.seasonal import seasonal_decompose #decomposesion'seasonality and tren
from statsmodels.tsa.stattools import adfuller #'test'
from statsmodels.tsa.arima_model import ARIMA #algoritham
# from statsmodels.tsa.ar_model import AutoReg
# from statsmodels.tsa.vector_ar.var_model import VAR
from statsmodels.graphics.tsaplots import plot_acf
# from sklearn.metrics import mean_squared_error
# from sklearn import preprocessing
import warnings
warnings.filterwarnings('ignore')
sns.set()
```

In [2]:

```
#importing the data frame and concating
df1=pd.read_excel('E:/Documents/Alagasan/PG/Projects/Main Project/Sales DB/Retail sales.xls
df2=pd.read_excel('E:/Documents/Alagasan/PG/Projects/Main Project/Sales DB/Retail sales 2.x
frame=[df1,df2]
df=pd.concat(frame)
df.head(5)
```

Out[2]:

	Order Id	Sequence No	Delivery Type	Created Date	Created Time	Order Status	Order Item Status	Payment Type	Locatio Nam
0	2003504	\t(No Sequence No Info Available)	other	2020-01-01	06:49:00	\tcompleted	\tCompleted	Card	Mylapor Stor
1	2003504	\t(No Sequence No Info Available)	other	2020-01-01	06:49:00	\tcompleted	\tCompleted	Card	Mylapor Stor
2	2003504	\t(No Sequence No Info Available)	other	2020-01-01	06:49:00	\tcompleted	\tCompleted	Card	Mylapor Stor
3	2003513	\t(No Sequence No Info Available)	other	2020-01-01	07:03:00	\tcompleted	\tCompleted	Cash	Z Pallavarar
4	2003517	\t(No Sequence No Info Available)	other	2020-01-01	07:09:00	\tcompleted	\tCompleted	Cash	Selaiyu Stor

5 rows × 52 columns

In [3]:

```
df.shape
```

Out[3]:

```
(1246984, 52)
```

In [4]:

```
#describing the numerical values
df.describe()
```

Out[4]:

	Order Id	Phone Number	SKU	MRP	Unit Selling Price	Quantity	
count	1.246984e+06	1.610600e+04	1.246977e+06	1.246984e+06	1.246984e+06	1.246984e+06	1
mean	2.499588e+06	9.240458e+09	1.236910e+05	5.886790e+01	6.128735e+01	9.780666e-01	1
std	2.146642e+05	8.323990e+08	9.629060e+04	7.486572e+01	7.407572e+01	1.454583e+00	2
min	2.003504e+06	6.245896e+09	1.815000e+04	0.000000e+00	0.000000e+00	0.000000e+00	0
25%	2.342731e+06	8.980674e+09	1.001780e+05	9.000000e+00	2.500000e+01	4.550000e-01	0
50%	2.580116e+06	9.551536e+09	1.002600e+05	4.000000e+01	4.250000e+01	1.000000e+00	0
75%	2.661126e+06	9.841626e+09	1.004140e+05	7.800000e+01	7.200000e+01	1.000000e+00	0
max	3.233248e+06	9.999235e+09	9.619001e+07	3.999000e+03	4.080000e+03	6.400000e+02	4

8 rows × 33 columns

In [5]:

```
df.describe(include='object')
# unique tells total type of data
# top tells top data which is repeated often
# feq tells number of top data
```

Out[5]:

	Sequence No	Delivery Type	Created Time	Order Status	Order Item Status	Payment Type	Location Name	Employee Id
count	1246984	1246984	1246984	1246984	1246984	1246984	1246984	1246984
unique	25640	1	1332	3	3	14	11	44
top	\t(No Sequence No Info Available)	other	11:25:00	\tcompleted	\tCompleted	Cash	Neelankarai Store	
freq	412508	1246984	2782	1099690	1242537	431498	248274	259578

In [6]:

```
#Checking for missing values in date sequence
pd.date_range(start='2020-01-01',end='2020-06-30').difference(df.index)
```

Out[6]:

```
DatetimeIndex(['2020-01-01', '2020-01-02', '2020-01-03', '2020-01-04',
               '2020-01-05', '2020-01-06', '2020-01-07', '2020-01-08',
               '2020-01-09', '2020-01-10',
               ...
               '2020-06-21', '2020-06-22', '2020-06-23', '2020-06-24',
               '2020-06-25', '2020-06-26', '2020-06-27', '2020-06-28',
               '2020-06-29', '2020-06-30'],
              dtype='datetime64[ns]', length=182, freq=None)
```

In [7]:

```
#sorting date
df=df.sort_values(by=['Created Date'])
```

In [8]:

```
#Checking for null value in gross sales column and Created Date column
df.isnull().sum()
```

Out[8]:

```
Order Id
0
Sequence No
0
Delivery Type
0
Created Date
0
Created Time
0
Order Status
0
Order Item Status
0
Payment Type
0
Location Name
0
Employee Id
0
Employee Name
0
Customer Name
0
Customer Code
0
TRN/GSTIN
0
Phone Number
1230878
Item Name
0
Variation Name
0
Category
0
SKU
7
HSN
995118
MRP
0
Unit Selling Price
0
Quantity
0
Unit Of Measure
0
CESS 12%
0
CGST 14%
0
CGST 2.5%
```

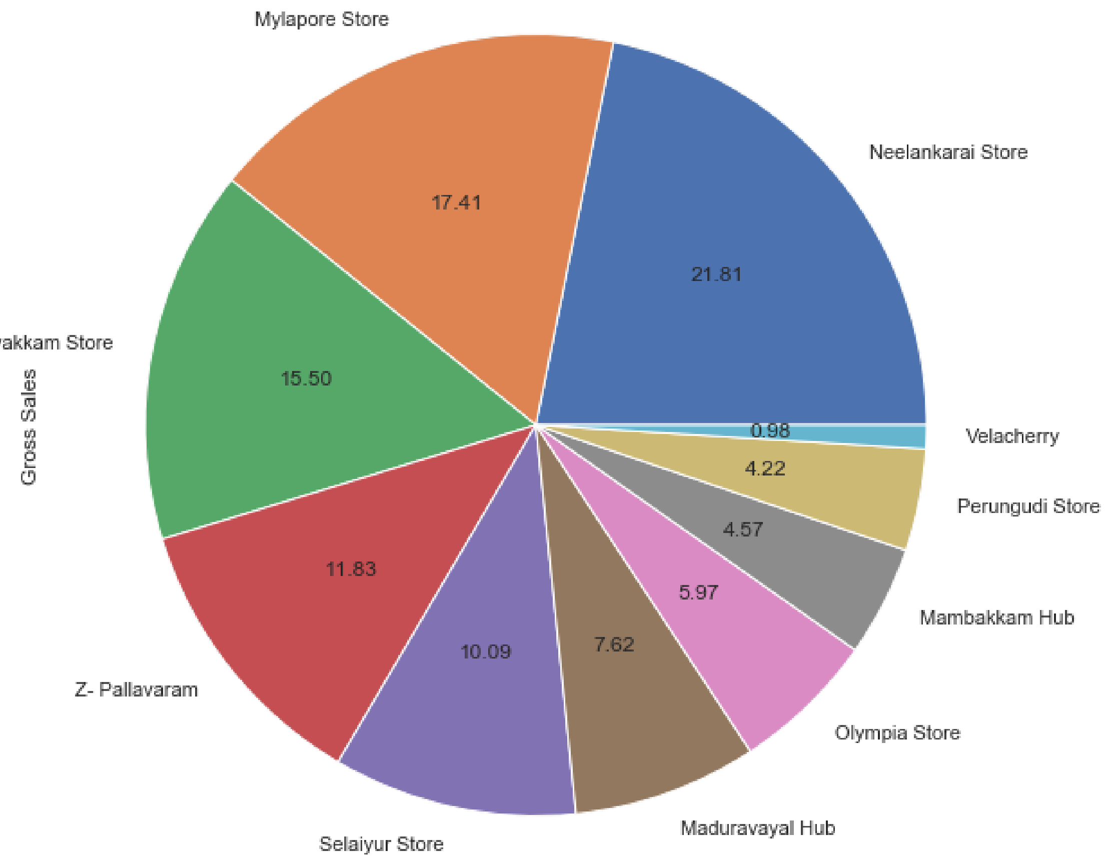
```
0
CGST 6%
0
CGST 9%
0
Exclusive VAT 5%
0
Exempt VAT 0%
0
GST
0
GST 0%
0
Inclusive VAT 5%
0
SGST 14%
0
SGST 2.5%
0
SGST 6%
0
SGST 9%
0
Total Tax
0
Tax Rate %
0
Discounted Amount
0
Discounted Tax
0
Discount
0
Sales Return/Refunded Qty
0
Sales Return/Refunded Amount
0
Sales Return/Refunded Tax
0
Sales Returns/Total Refunds
0
Items Sold
0
Gross Sales
0
Net Sales(Gross Sales - Sales Return/Refunded Amount - Discounted Amount)
0
Net Tax Collected(Total Tax - Discounted Tax - Sales Return/Refunded Tax)
0
Net Total(Net Sales + Net Tax Collected)
0
dtype: int64
```

In [9]:

```
#top 10 location wise data
plt.subplots(figsize=(10,10))
df.groupby('Location Name')['Gross Sales'].sum().sort_values(ascending=False).head(10).plot
```

Out[9]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1ae9cf6d588>
```

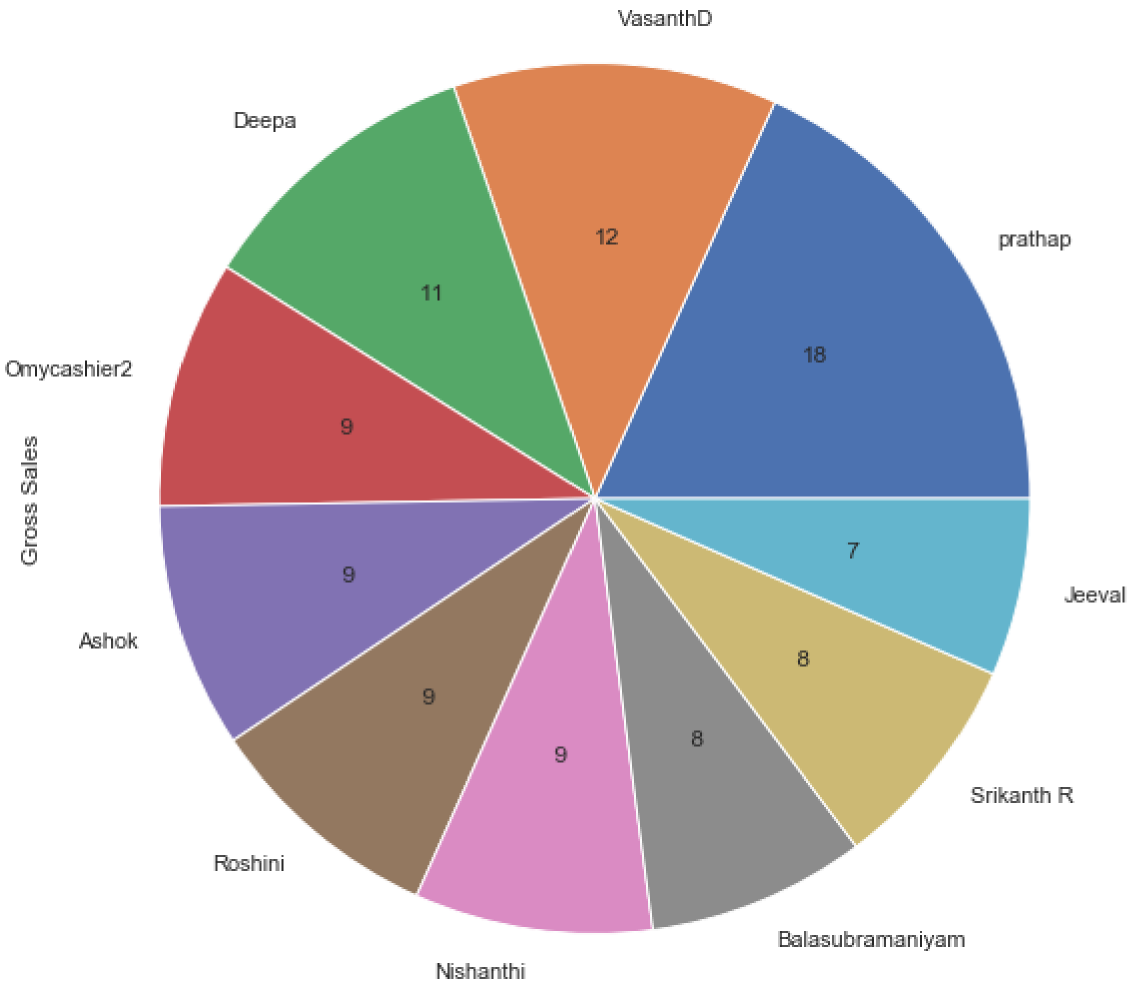


In [10]:

```
plt.subplots(figsize=(10,10))
df[df['Employee Name']!='(No Employee Name)'].groupby('Employee Name')['Gross Sales'].sum()
```

Out[10]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1ae85d33508>
```

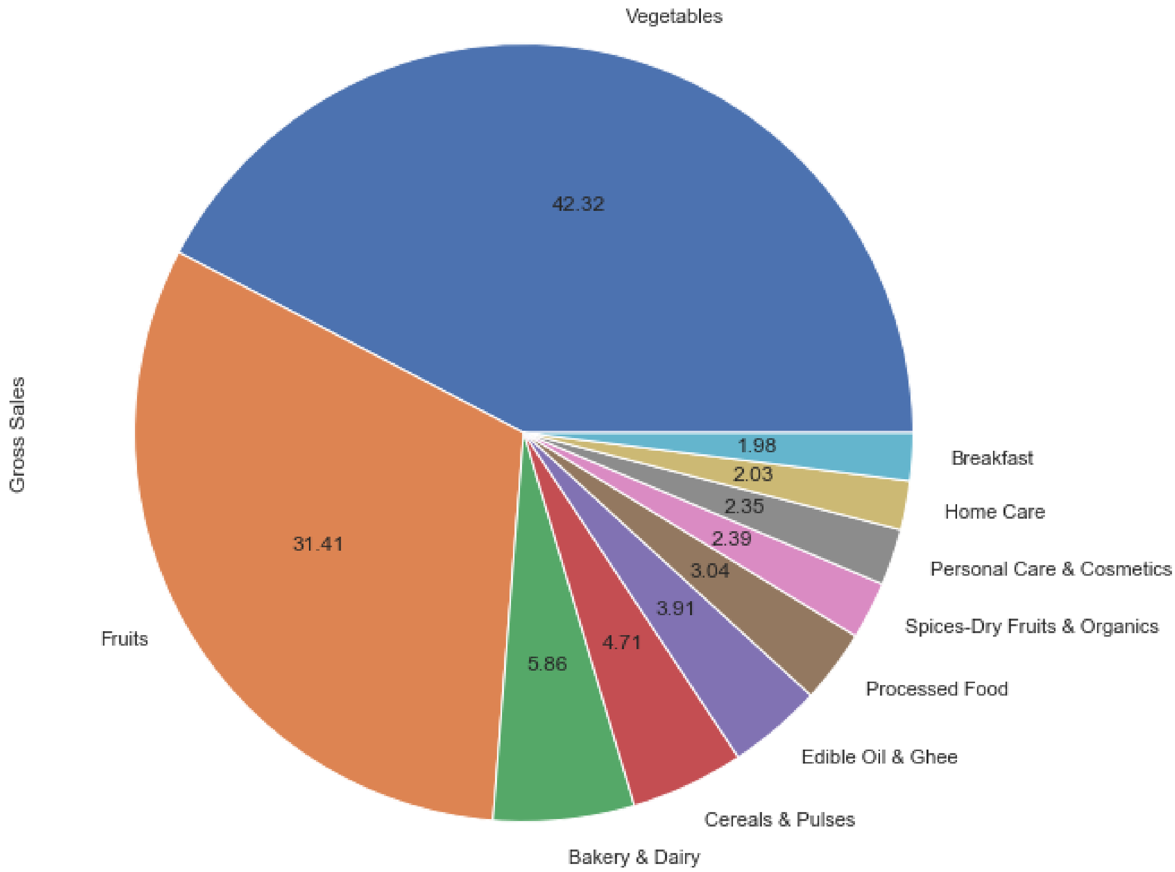


In [11]:

```
plt.subplots(figsize=(10,10))
df.groupby('Category')['Gross Sales'].sum().sort_values(ascending=False).head(10).plot(kind
```

Out[11]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1aedae10d48>
```



In [12]:

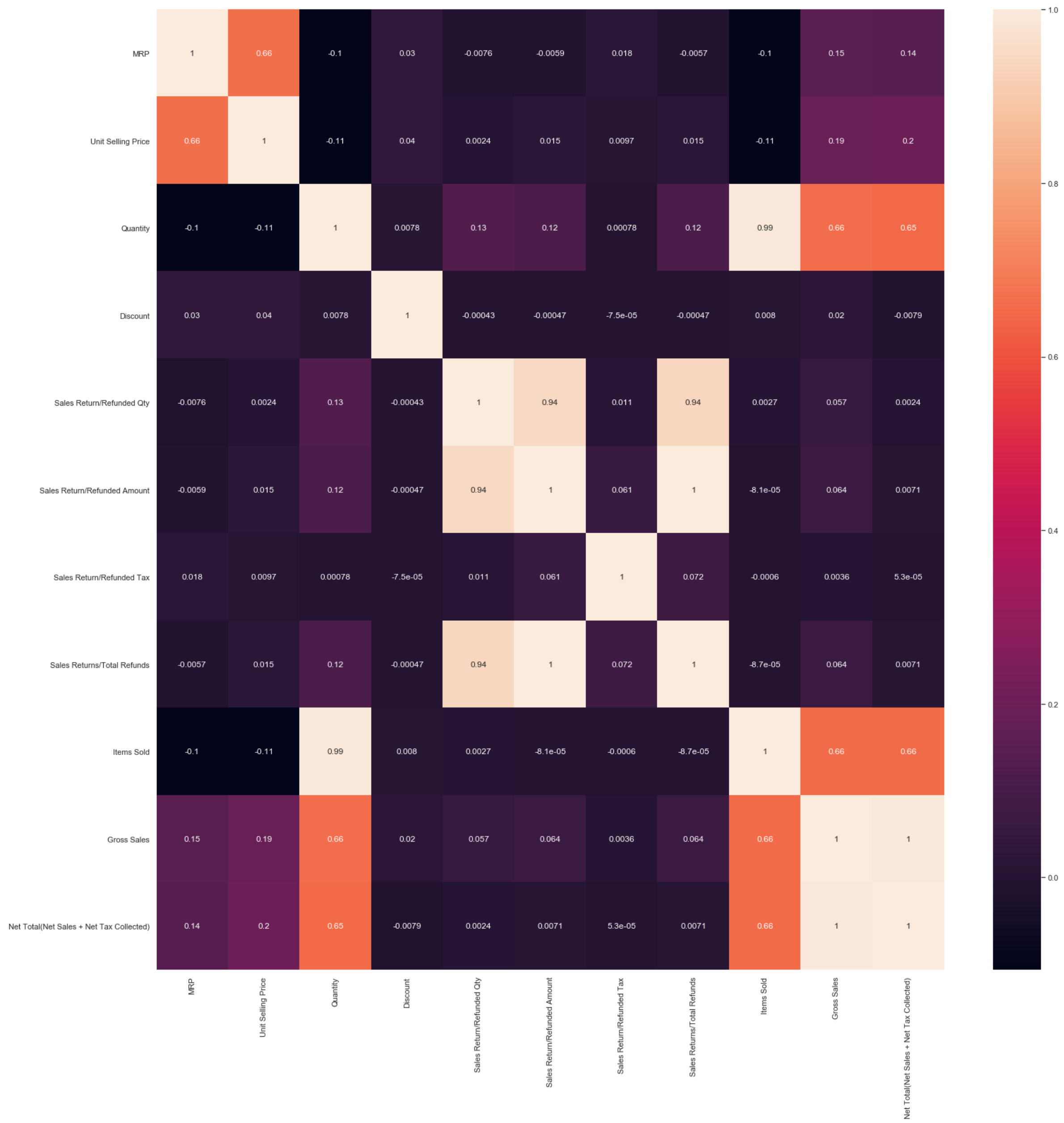
```
# ploting correlation heat map for all numerical items
imp_df=df[["MRP","Unit Selling Price","Quantity",'Discount',
 'Sales Return/Refunded Qty',
 'Sales Return/Refunded Amount',
 'Sales Return/Refunded Tax',
 'Sales Returns/Total Refunds',
 'Items Sold',
 'Gross Sales',
 'Net Total(Net Sales + Net Tax Collected)']]
```

In [13]:

```
plt.subplots(figsize=(25,25))
sns.heatmap(imp_df.corr(),annot=True)
```

Out[13]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1af03054708>
```



In [14]:

```
df["Created_month"]=df["Created Date"].dt.month_name()
```

In [15]:

```
df["Created_week"] = df["Created Date"].dt.week
```

In [16]:

```
df.groupby(by=['Created_week'],as_index=False)['Gross Sales'].count()
```

Out[16]:

	Created_week	Gross Sales
0	1	38136
1	2	52173
2	3	38364
3	4	42033
4	5	42847
5	6	49555
6	7	45353
7	8	48877
8	9	43462
9	10	47855
10	11	55693
11	12	66782
12	13	57476
13	14	51771
14	15	54281
15	16	46695
16	17	44556
17	18	33508
18	19	51133
19	20	56754
20	21	43336
21	22	43778
22	23	42132
23	24	44995
24	25	45709
25	26	44800
26	27	14930

In [17]:

```
# Removing 27th week because there is not enough data points
df = df[df.Created_week!=27]
```

In [18]:

```
df.groupby(by=['Created_week'],as_index=False)['Gross Sales'].count()
```

Out[18]:

	Created_week	Gross Sales
0	1	38136
1	2	52173
2	3	38364
3	4	42033
4	5	42847
5	6	49555
6	7	45353
7	8	48877
8	9	43462
9	10	47855
10	11	55693
11	12	66782
12	13	57476
13	14	51771
14	15	54281
15	16	46695
16	17	44556
17	18	33508
18	19	51133
19	20	56754
20	21	43336
21	22	43778
22	23	42132
23	24	44995
24	25	45709
25	26	44800

In [19]:

```
dft = df.groupby(by=['Created_week'],as_index=False)['Gross Sales'].sum()
```

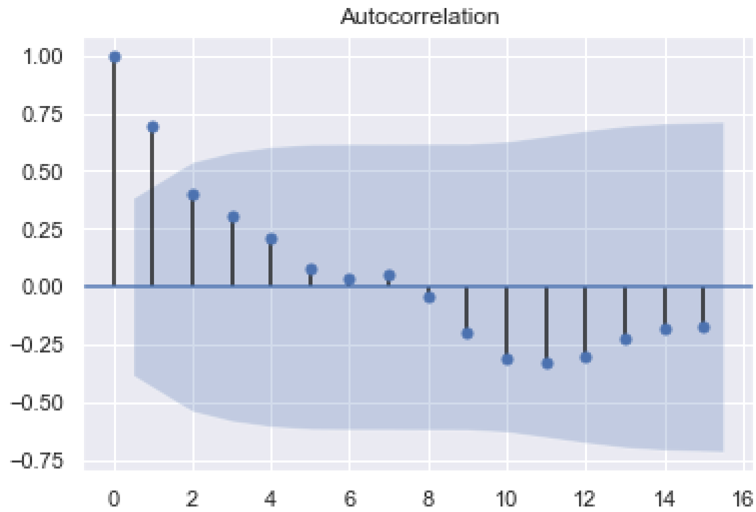
In [20]:

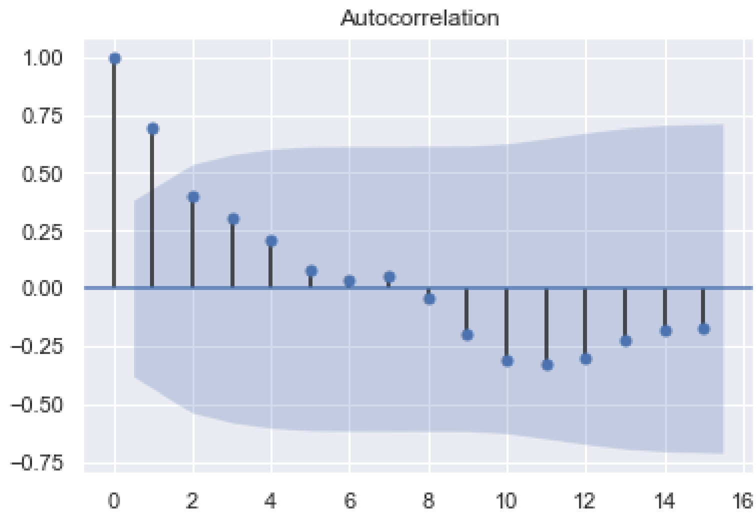
```
dft = dft.set_index("Created_week")
```

In [21]:

```
# Checking auto-correlation
plot_acf(dft)
```

Out[21]:





In [22]:

```
plt.subplots(figsize=(20,7))
plt.plot(dft["Gross Sales"])
plt.title("Total Gross Sales")
```

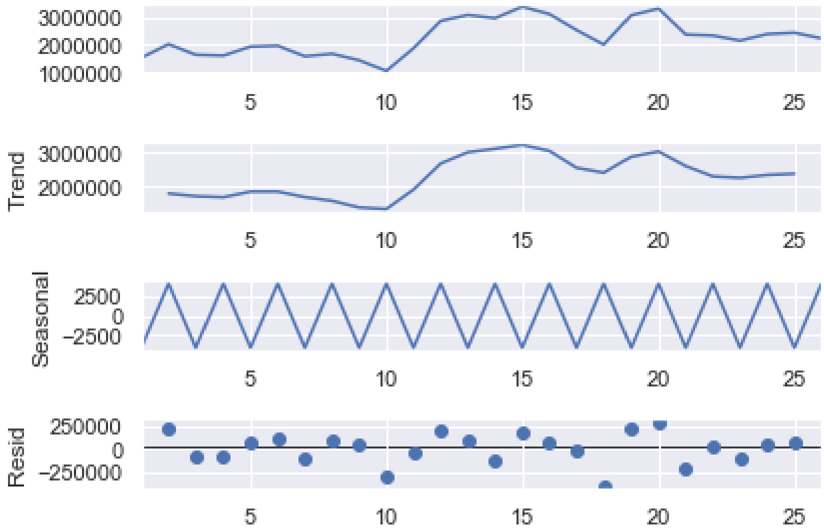
Out[22]:

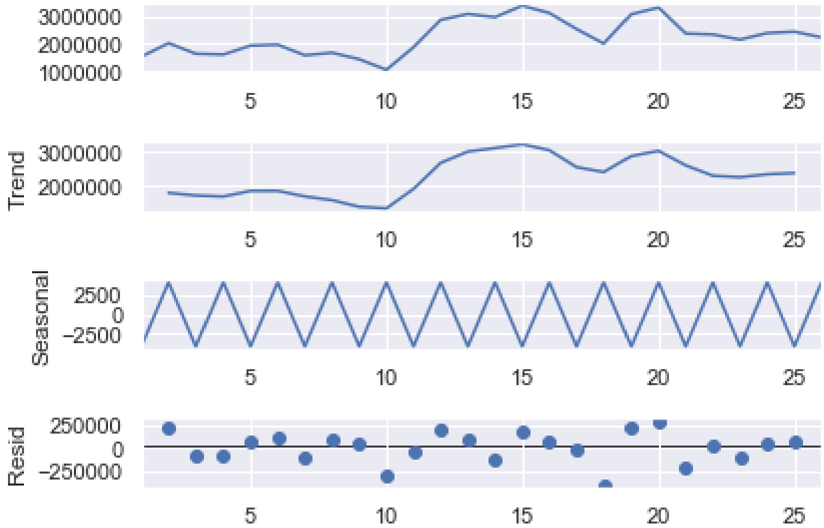
```
Text(0.5, 1.0, 'Total Gross Sales')
```

In [23]:

```
splot=seasonal_decompose(dft,model='additive',freq=2)
splot.plot()
```

Out[23]:





In [24]:

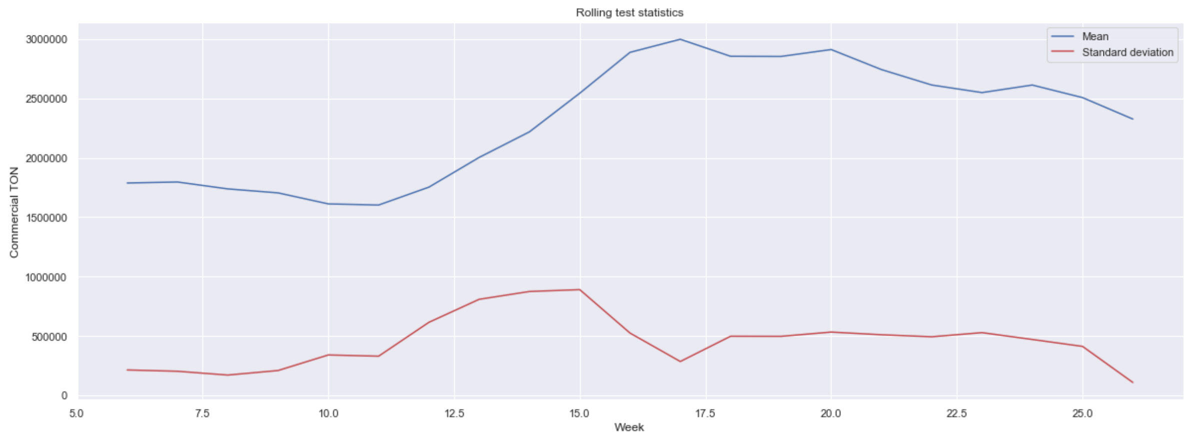
```
def rolling_statistics(dataframe):
    (plt.subplots(figsize=(20,7)))
    (plt.plot(dft.rolling(window=6).mean(),color='b',label='Mean'))
    (plt.plot(dft.rolling(window=6).std(),color='r',label='Standard deviation'))
    (plt.legend(loc='best'))
    (plt.xlabel("Week",color='k'))
    (plt.ylabel("Commercial TON",color='k'))
    plt.title("Rolling test statistics")
```

In [25]:

```
def adf(dataframe_column):
    df_test = adfuller(dataframe_column,autolag='AIC')
    print("P-value for ADF test- ",df_test[1])
    if df_test[1] > 0.05:
        print("The data is not stationery")
    else:
        print("The data is stationery")
```

In [26]:

```
rolling_statistics(dft)
```



In [27]:

```
print("There is variance, data does not look stationery")
```

```
There is variance, data does not look stationery
```

In [28]:

```
adf(dft['Gross Sales'])
```

```
P-value for ADF test-  0.22691082677472596
The data is not stationery
```

In [29]:

```
# Below steps to make data stationery, this process is know as decomposing the data
```

In [30]:

```
def transformation(dataframe_column):
    return np.log(dataframe_column)
```

In [31]:

```
# Taking log will reduce the diffrence between the data point
dft_logged = transformation(dft)
dft_logged
```

Out[31]:

	Gross Sales
Created_week	
1	14.244703
2	14.521769
3	14.312056
4	14.294041
5	14.477035
6	14.493514
7	14.276624
8	14.333406
9	14.181163
10	13.870996
11	14.446952
12	14.871151
13	14.943127
14	14.904783
15	15.036889
16	14.954421
17	14.747910
18	14.515373
19	14.940432
20	15.016179
21	14.682246
22	14.666866
23	14.584250
24	14.688959
25	14.709492
26	14.621411

In [32]:

```
adf(dft_logged['Gross Sales'])
```

```
P-value for ADF test-  0.44873826797603167
The data is not stationery
```

In [33]:

```
# Differencing will make first week data 'nan - not a number'
dft_diff = dft_logged.diff(axis = 0, periods = 1).dropna()
dft_diff
```

Out[33]:

	Gross Sales
Created_week	
2	0.277067
3	-0.209714
4	-0.018015
5	0.182994
6	0.016479
7	-0.216890
8	0.056782
9	-0.152243
10	-0.310166
11	0.575955
12	0.424199
13	0.071977
14	-0.038345
15	0.132106
16	-0.082468
17	-0.206512
18	-0.232537
19	0.425059
20	0.075747
21	-0.333933
22	-0.015381
23	-0.082616
24	0.104709
25	0.020533
26	-0.088080

In [34]:

```
adf(dft_diff['Gross Sales'])
```

```
P-value for ADF test-  6.093497993041613e-05
The data is stationery
```

In [35]:

```
dft_diff.shape
```

Out[35]:

```
(25, 1)
```

In [36]:

```
# below steps to split data into test and train
```

In [37]:

```
df_train = dft_diff[0:20]
df_test = dft_diff[20:]
```

In [38]:

```
# below steps to find best parameters for model
```

In [39]:

```
p=i=q=range(0,5)
piq = itertools.product(p,i,q)
piq=list(piq)
```

In [40]:

```
for param in piq:
    try:
        model = ARIMA(df_train,order=param)
        results_AR = model.fit(disp=-1)
        print(param,results_AR.aic)
    except:
        continue
#checking the combination in which is error is less
#arima=it is a linera line with combination of auto regression and moving avg., it is one o
```

```
(0, 0, 0) 5.3396708331527485
(0, 0, 1) 7.312666708352637
(0, 0, 2) 2.539386614444581
(0, 0, 3) 4.223227729540298
(0, 0, 4) nan
(0, 1, 0) 17.618796045718426
(0, 1, 1) 11.118514284530072
(0, 1, 2) 12.378604494088655
(0, 1, 3) 11.525403013527956
(0, 1, 4) 12.817695759727727
(0, 2, 0) 32.33896490126659
(0, 2, 1) 22.80562639567726
(0, 2, 2) 19.852078229650658
(0, 2, 3) 20.43878043136875
(0, 2, 4) 21.154230528577934
(1, 0, 0) 7.338894390487781
(1, 0, 1) 7.763742197915867
(1, 0, 2) 4.309225290038533
(1, 0, 3) 4.692296867390979
(1, 1, 0) 18.79515898334452
(1, 1, 1) 13.018518710245125
(1, 1, 2) 13.333493587583554
(1, 1, 3) 13.002835001015796
(1, 1, 4) 13.381787942186776
(1, 2, 0) 31.903965472999896
(2, 0, 0) 5.008300142497575
(2, 0, 1) 6.479871558817003
(2, 0, 2) 6.2147023321388986
(2, 0, 3) 6.394494916132146
(2, 0, 4) 8.239760384719773
(2, 1, 0) 12.481396665784942
(2, 1, 1) 11.611987098694001
(2, 1, 2) 12.951960196369697
(2, 1, 3) 13.76488495455758
(2, 1, 4) 14.990055518369402
(2, 2, 0) 25.34424953414544
(3, 0, 0) 6.52463122938633
(3, 0, 1) 8.427417983877334
(3, 0, 2) 7.897353017062528
(3, 0, 3) 8.245157937554609
(3, 0, 4) 8.89752919462272
(3, 1, 0) 14.054872059149666
(3, 1, 1) 12.829848141465042
(3, 1, 2) 15.43047683772513
(3, 1, 3) 15.8188518597484
(3, 1, 4) 17.047743992468398
(3, 2, 0) 23.333989654335824
(3, 2, 1) 21.351072704341867
```

```
(3, 2, 2) 23.053438566431034
(4, 0, 0) 8.010699233776208
(4, 0, 1) 5.275447678012824
(4, 1, 0) 16.052008666164262
(4, 1, 1) 14.591929654189407
(4, 1, 2) 17.479359776729332
(4, 1, 3) 17.592750677397014
(4, 1, 4) 17.44916195907706
(4, 2, 0) 25.09298585354494
(4, 2, 1) 23.319968938975506
(4, 2, 2) 25.030740769010286
```

In [41]:

```
# below we are fitting the model
```

In [42]:

```
model = ARIMA(df_train,order=(4, 0, 1))
results_AR = model.fit()
print(param,results_AR.aic)

#using 4,4,4 bcz is fits the model
```

```
(4, 4, 4) 5.275447678012824
```

In [43]:

```
print("Printing predictions")
results_AR.predict(start=20,end=27)
```

```
Printing predictions
```

Out[43]:

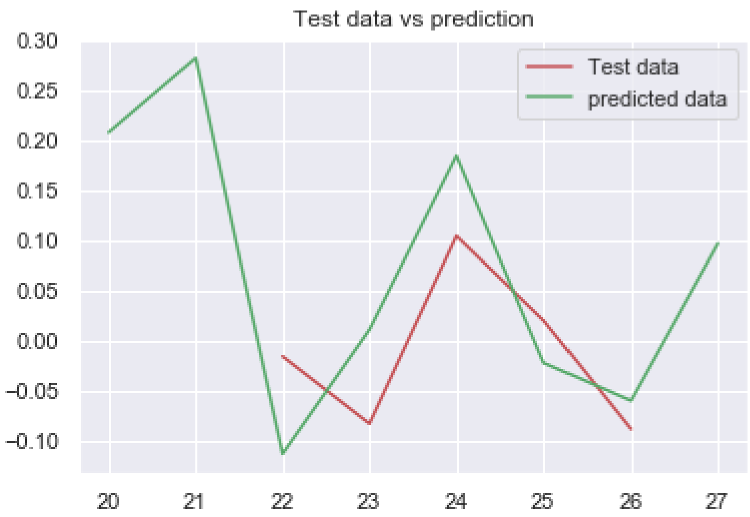
```
20    0.207931
21    0.282272
22   -0.112820
23    0.011319
24    0.184640
25   -0.021826
26   -0.059695
27    0.097043
dtype: float64
```

In [44]:

```
plt.plot(df_test,color="r")
plt.plot(results_AR.predict(start=20,end=27),color='g')
plt.title("Test data vs prediction")
plt.legend(["Test data", "predicted data"], loc ="top right")
```

Out[44]:

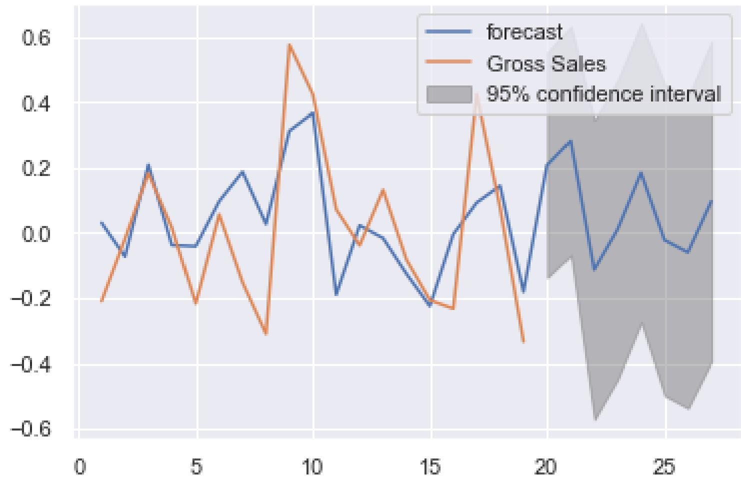
```
<matplotlib.legend.Legend at 0x1ae8dd75788>
```

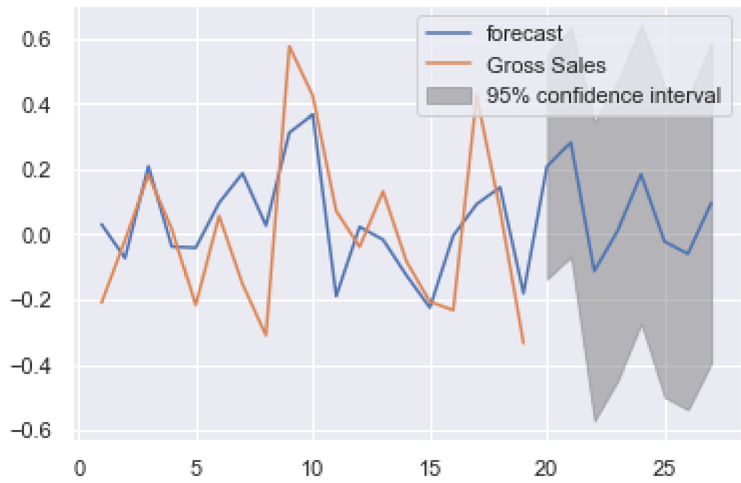


In [45]:

```
results_AR.plot_predict(1,27)
```

Out[45]:





In [46]:

```
# Following code normalizes the test data (predicted data)
```

In [47]:

```
cols = dft_logged.columns
x = []
for col in cols:
    diff_results = dft_logged[col] + results_AR.predict(start=1,end=26).shift(-1)
    x.append(diff_results)
diff_df_inverted = pd.concat(x, axis=1)
```

In [48]:

```
predicted_dataframe = np.exp(diff_df_inverted[:-1]).astype(str)
```

In [49]:

```
predicted_dataframe = predicted_dataframe.rename(columns={0:"Gross Sales"})
```

In [50]:

```
predicted_dataframe['Gross Sales'] = predicted_dataframe['Gross Sales'].str.split(".",expan
```

In [51]:

```
predicted_dataframe[21:]
```

Out[51]:

	Gross Sales
Created_week	
22	2369489
23	2594461
24	2343445
25	2303169

In [52]:

```
#out put is generated above
```