Experimentation and uplift testing

```python
#imports
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns

from plotly.offline import init_notebook_mode, iplot
init_notebook_mode(connected=True)
import plotly.offline as offline
offline.init_notebook_mode()
import cufflinks as cf
cf.go_offline()

data = pd.read_csv(r"C:\Users\Preeti\Desktop\Certifications\
Quantium_Virtual_Internship\QVI_data (1).csv")
data.head()
```

```
   LYLTY_CARD_NBR        DATE  STORE_NBR  TXN_ID  PROD_NBR  \
0            1000  2018-10-17          1       1         5
1            1002  2018-09-16          1       2        58
2            1003  2019-03-07          1       3        52
3            1003  2019-03-08          1       4       106
4            1004  2018-11-02          1       5        96


                             PROD_NAME  PROD_QTY  TOT_SALES
PACK_SIZE  \
0  Natural Chip        Compny SeaSalt175g         2        6.0
175
1    Red Rock Deli Chikn&Garlic Aioli 150g        1        2.7
150
2    Grain Waves Sour     Cream&Chives 210G       1        3.6
210
3  Natural ChipCo        Hony Soy Chckn175g        1        3.0
175
4           WW Original Stacked Chips 160g        1        1.9
160


         BRAND             LIFESTAGE PREMIUM_CUSTOMER
0     NATURAL   YOUNG SINGLES/COUPLES          Premium
1         RRD   YOUNG SINGLES/COUPLES       Mainstream
2     GRNWVES           YOUNG FAMILIES           Budget
3     NATURAL           YOUNG FAMILIES           Budget
4  WOOLWORTHS   OLDER SINGLES/COUPLES       Mainstream
```

```python
data['DATE'] = pd.to_datetime(data['DATE'])

data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 264834 entries, 0 to 264833
Data columns (total 12 columns):
 #   Column            Non-Null Count   Dtype
---  ------            --------------   -----
 0   LYLTY_CARD_NBR    264834 non-null  int64
 1   DATE              264834 non-null  datetime64[ns]
 2   STORE_NBR         264834 non-null  int64
 3   TXN_ID            264834 non-null  int64
 4   PROD_NBR          264834 non-null  int64
 5   PROD_NAME         264834 non-null  object
 6   PROD_QTY          264834 non-null  int64
 7   TOT_SALES         264834 non-null  float64
 8   PACK_SIZE         264834 non-null  int64
 9   BRAND             264834 non-null  object
 10  LIFESTAGE         264834 non-null  object
 11  PREMIUM_CUSTOMER  264834 non-null  object
dtypes: datetime64[ns](1), float64(1), int64(6), object(4)
memory usage: 24.2+ MB
```

```
data['YEARMONTH']=[s.year*100+s.month for s in data['DATE']]
data
```

```
        LYLTY_CARD_NBR       DATE  STORE_NBR  TXN_ID  PROD_NBR  \
0                 1000 2018-10-17          1       1         5
1                 1002 2018-09-16          1       2        58
2                 1003 2019-03-07          1       3        52
3                 1003 2019-03-08          1       4       106
4                 1004 2018-11-02          1       5        96
...                ...        ...        ...     ...       ...
264829         2370701 2018-12-08         88  240378        24
264830         2370751 2018-10-01         88  240394        60
264831         2370961 2018-10-24         88  240480        70
264832         2370961 2018-10-27         88  240481        65
264833         2373711 2018-12-14         88  241815        16

                                   PROD_NAME  PROD_QTY  TOT_SALES  \
0          Natural Chip        Compny SeaSalt175g         2        6.0

1            Red Rock Deli Chikn&Garlic Aioli 150g         1        2.7

2            Grain Waves Sour    Cream&Chives 210G         1        3.6

3          Natural ChipCo      Hony Soy Chckn175g         1        3.0

4                  WW Original Stacked Chips 160g         1        1.9

...                                        ...       ...        ...
```

```
264829      Grain Waves           Sweet Chilli 210g        2        7.2

264830      Kettle Tortilla ChpsFeta&Garlic 150g           2        9.2

264831  Tyrrells Crisps     Lightly Salted 165g            2        8.4

264832  Old El Paso Salsa   Dip Chnky Tom Ht300g           2       10.2

264833  Smiths Crinkle Chips Salt & Vinegar 330g           2       11.4


        PACK_SIZE        BRAND              LIFESTAGE PREMIUM_CUSTOMER
\
0             175      NATURAL  YOUNG SINGLES/COUPLES          Premium

1             150          RRD  YOUNG SINGLES/COUPLES       Mainstream

2             210      GRNWVES          YOUNG FAMILIES           Budget

3             175      NATURAL          YOUNG FAMILIES           Budget

4             160   WOOLWORTHS  OLDER SINGLES/COUPLES       Mainstream

...           ...          ...                    ...              ...

264829        210      GRNWVES          YOUNG FAMILIES       Mainstream

264830        150       KETTLE          YOUNG FAMILIES          Premium

264831        165     TYRRELLS          OLDER FAMILIES           Budget

264832        300          OLD          OLDER FAMILIES           Budget

264833        330       SMITHS  YOUNG SINGLES/COUPLES       Mainstream


        YEARMONTH
0          201810
1          201809
2          201903
3          201903
4          201811
...           ...
264829     201812
264830     201810
264831     201810
264832     201810
264833     201812
```

[264834 rows x 13 columns]

METRICS UNDER CONSIDERATION:

Monthly overall sales revenue

Monthly number of customers

Monthly number of transactions per customer

```python
metrics=data.groupby(['STORE_NBR','YEARMONTH']).agg({'TOT_SALES':'sum'
,'LYLTY_CARD_NBR':'nunique','TXN_ID':'nunique','PROD_QTY':'sum'})
metrics['PRICE_PER_UNIT']=metrics['TOT_SALES']/metrics['PROD_QTY']
metrics['CHIP_PER_TXN']=metrics['PROD_QTY']/metrics['TXN_ID']
metrics=metrics.rename(columns={'LYLTY_CARD_NBR':'CUSTOMERS'})
metrics['TXN_PER_CUST']=metrics['TXN_ID']/metrics['CUSTOMERS']
metrics.drop(['TXN_ID'],axis=1,inplace=True)

full=metrics.copy()

#taking data before 2019-02 into consideration
trial=[]
for i in metrics.index:
    if(i[1]>=201902):
        if(i[1]<=201904):
            trial.append(metrics.loc[i])
        metrics.drop(i,inplace=True)
trial=pd.DataFrame(trial)
```

Funtions to find correlation and magnitude of any store wih another store
```python
def calcCorr(store):
    '''
    input=store number which is to be compared
    output=dataframe with corelation coefficient values
    '''
    a=[]
    metrix=metrics[['TOT_SALES','CUSTOMERS']]#add metrics as required
e.g. ,'TXN_PER_CUST'
    for i in metrix.index:
        a.append(metrix.loc[store].corrwith(metrix.loc[i[0]]))
    df= pd.DataFrame(a)
    df.index=metrix.index
    df=df.drop_duplicates()
    df.index=[s[0] for s in df.index]
    df.index.name="STORE_NBR"
    return df

def standardizer(df):
    '''
    input=dataframe with metrics
    output=dataframe with mean of the metrics in a new column
```

```
    '''
    df=df.abs()
    df['MAGNITUDE']=df.mean(axis=1)
    return df
```

Store 77
```
corr77=calcCorr(77)
corr77.head()
```

```
           TOT_SALES   CUSTOMERS
STORE_NBR
1            0.075218    0.322168
2           -0.263079   -0.572051
3            0.806644    0.834207
4           -0.263300   -0.295639
5           -0.110652    0.370659
```

```
corr77=standardizer(corr77)
corr77
```

```
           TOT_SALES   CUSTOMERS   MAGNITUDE
STORE_NBR
1            0.075218    0.322168    0.198693
2            0.263079    0.572051    0.417565
3            0.806644    0.834207    0.820426
4            0.263300    0.295639    0.279469
5            0.110652    0.370659    0.240655
...              ...         ...         ...
268          0.344757    0.369517    0.357137
269          0.315730    0.474293    0.395011
270          0.315430    0.131259    0.223345
271          0.355487    0.019629    0.187558
272          0.117622    0.223217    0.170420
```

```
[266 rows x 3 columns]
```

```
corr77=corr77.sort_values(['MAGNITUDE'],ascending=False).dropna()
corr77
```

```
           TOT_SALES   CUSTOMERS   MAGNITUDE
STORE_NBR
77           1.000000    1.000000    1.000000
233          0.903774    0.990358    0.947066
119          0.867664    0.983267    0.925466
71           0.914106    0.754817    0.834461
3            0.806644    0.834207    0.820426
...              ...         ...         ...
256          0.014245    0.047863    0.031054
159          0.001655    0.054404    0.028030
260          0.016618    0.027446    0.022032
194          0.010182    0.032053    0.021117
```
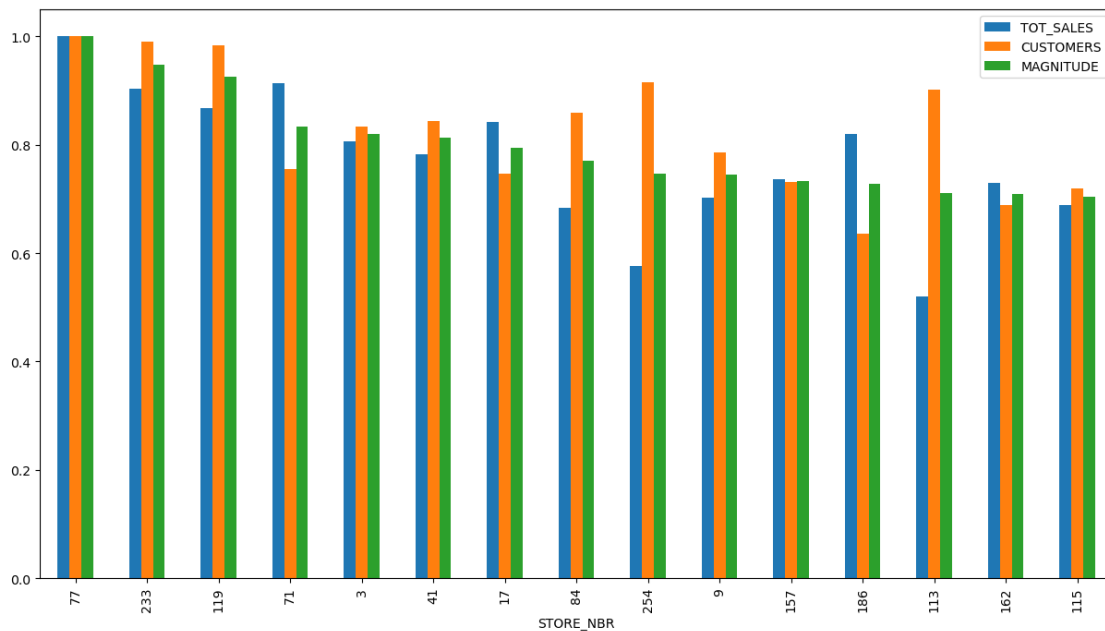
```
166         0.005875    0.012896    0.009386
```

```
[263 rows x 3 columns]
```

Visualizing
```
#Taking 0.7 as threshold corelation
corr77[(corr77.MAGNITUDE.abs()>0.7)].plot(kind='bar',figsize=(15,8))
```
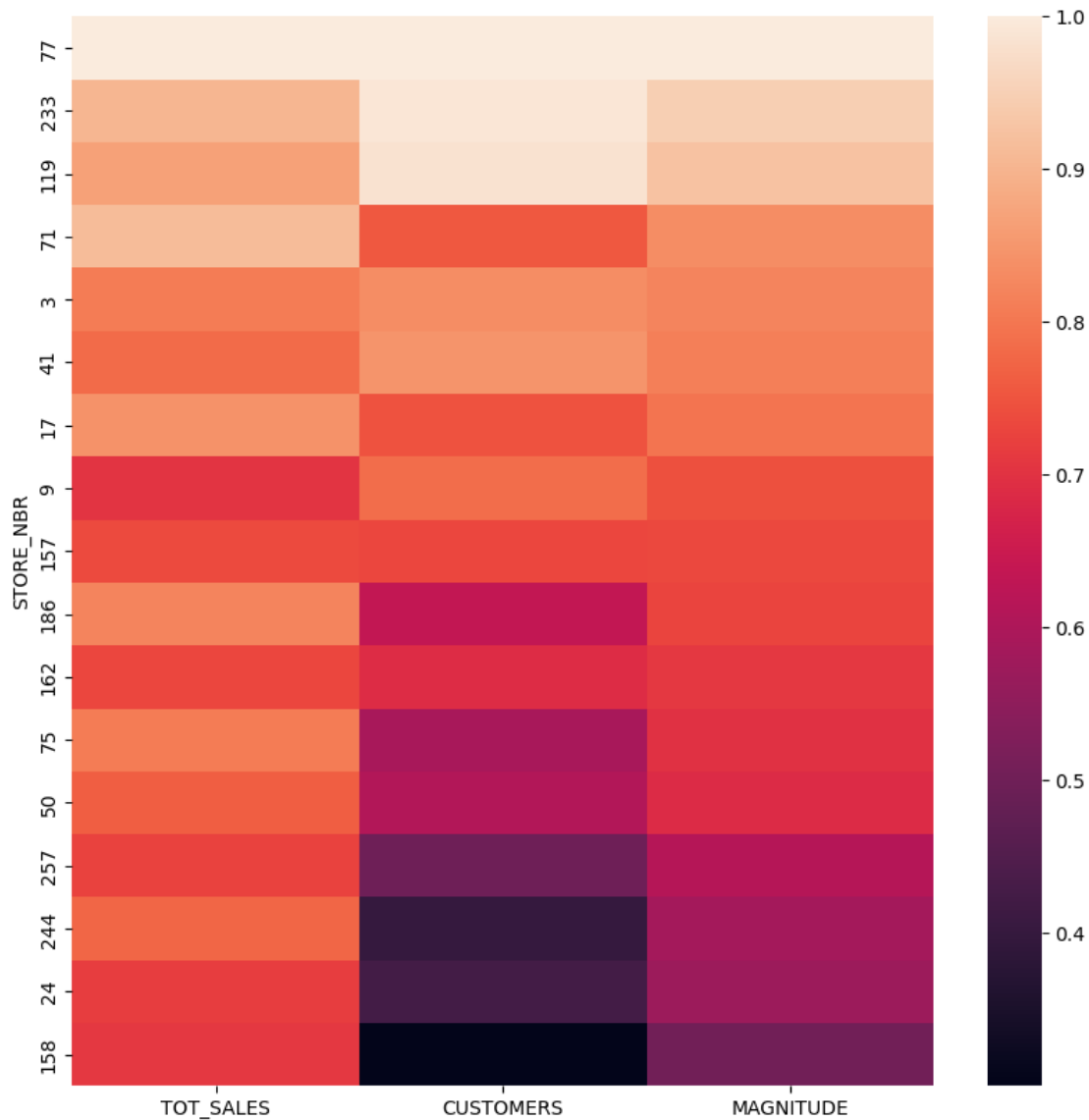
```
<AxesSubplot: xlabel='STORE_NBR'>
```



```
plt.figure(figsize=(10,10))
sns.heatmap(corr77[corr77.TOT_SALES.abs()>0.7])
```

```
<AxesSubplot: ylabel='STORE_NBR'>
```

Taking the store 233 into consideration plotting different measure against those of store 77

```python
sns.distplot(metrics.loc[77]['TOT_SALES'])
sns.distplot(metrics.loc[233]['TOT_SALES'])
plt.legend(labels=['77','233'])
```
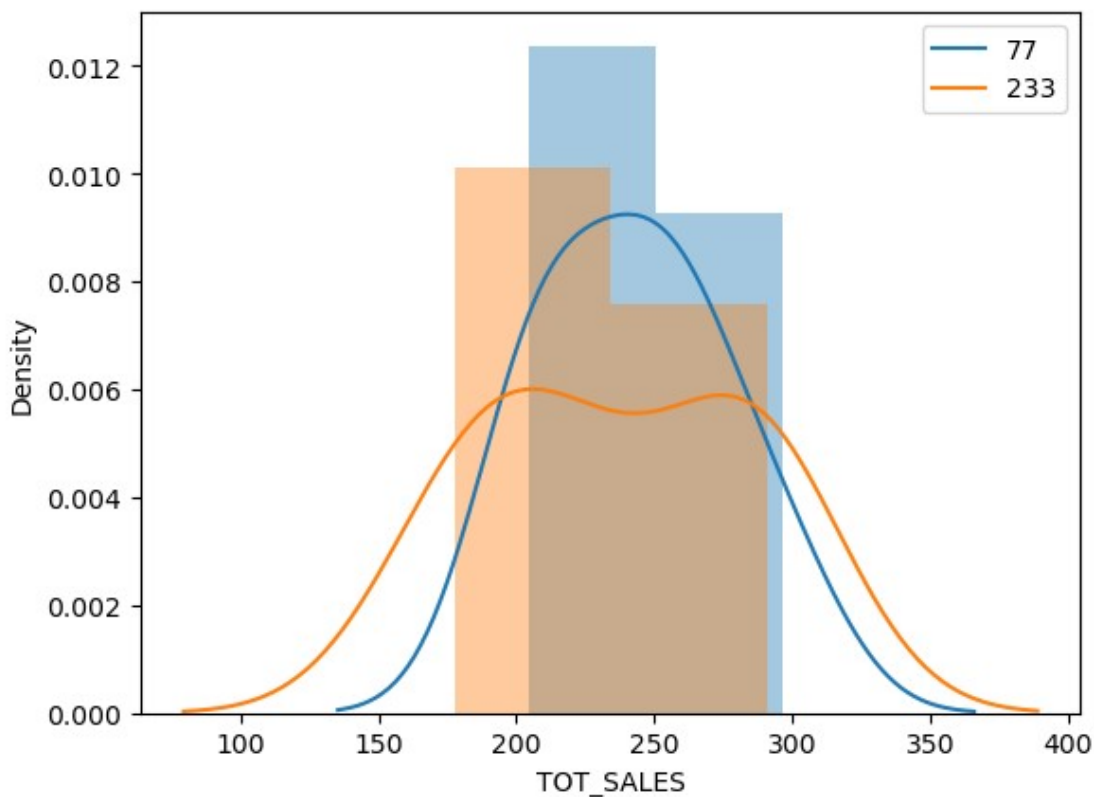
```
C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\3418971422.py:1:
UserWarning:



`distplot` is a deprecated function and will be removed in seaborn
v0.14.0.

Please adapt your code to use either `displot` (a figure-level
function with
```

similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\3418971422.py:2:
UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

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https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

<matplotlib.legend.Legend at 0x1cf5c70cc70>

```
sns.distplot(metrics.loc[77]['CUSTOMERS'])
sns.distplot(metrics.loc[233]['CUSTOMERS'])
plt.legend(labels=['77','233'])
```

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\512825119.py:1:
UserWarning:

`distplot` is a deprecated function and will be removed in seaborn
v0.14.0.

Please adapt your code to use either `displot` (a figure-level
function with
similar flexibility) or `histplot` (an axes-level function for
histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\512825119.py:2:
UserWarning:

`distplot` is a deprecated function and will be removed in seaborn
v0.14.0.

Please adapt your code to use either `displot` (a figure-level
function with
similar flexibility) or `histplot` (an axes-level function for
histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

<matplotlib.legend.Legend at 0x1cf5c6e9190>
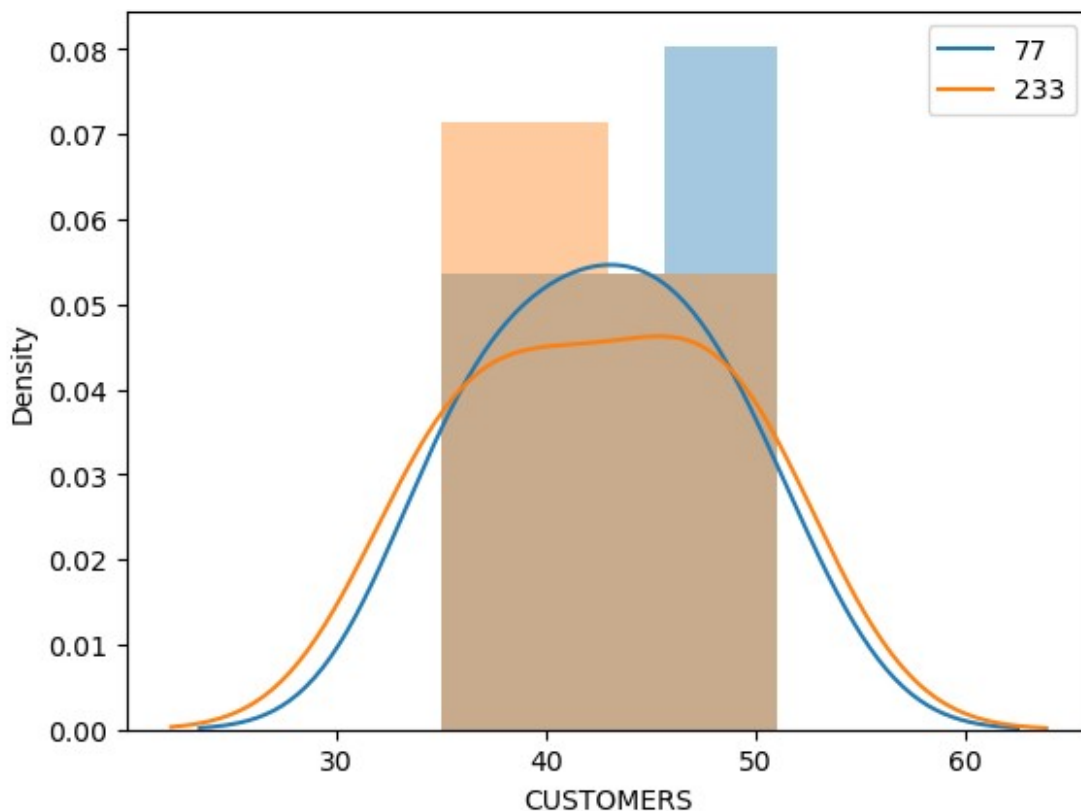
Since distributions of store 233 are similar to that of store 77, selecting store 233 as control store with max similarities to store 77

Calculating difference between scaled control sales and trial sales
```
sns.distplot(metrics.loc[77]['TXN_PER_CUST'])
sns.distplot(metrics.loc[233]['TXN_PER_CUST'])
plt.legend(labels=['77','233'])
```

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\3594496371.py:1:
UserWarning:

`distplot` is a deprecated function and will be removed in seaborn
v0.14.0.

Please adapt your code to use either `displot` (a figure-level
function with
similar flexibility) or `histplot` (an axes-level function for
histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\3594496371.py:2:
UserWarning:

`distplot` is a deprecated function and will be removed in seaborn
v0.14.0.

Please adapt your code to use either `displot` (a figure-level
function with
similar flexibility) or `histplot` (an axes-level function for
histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

<matplotlib.legend.Legend at 0x1cf5c55b340>
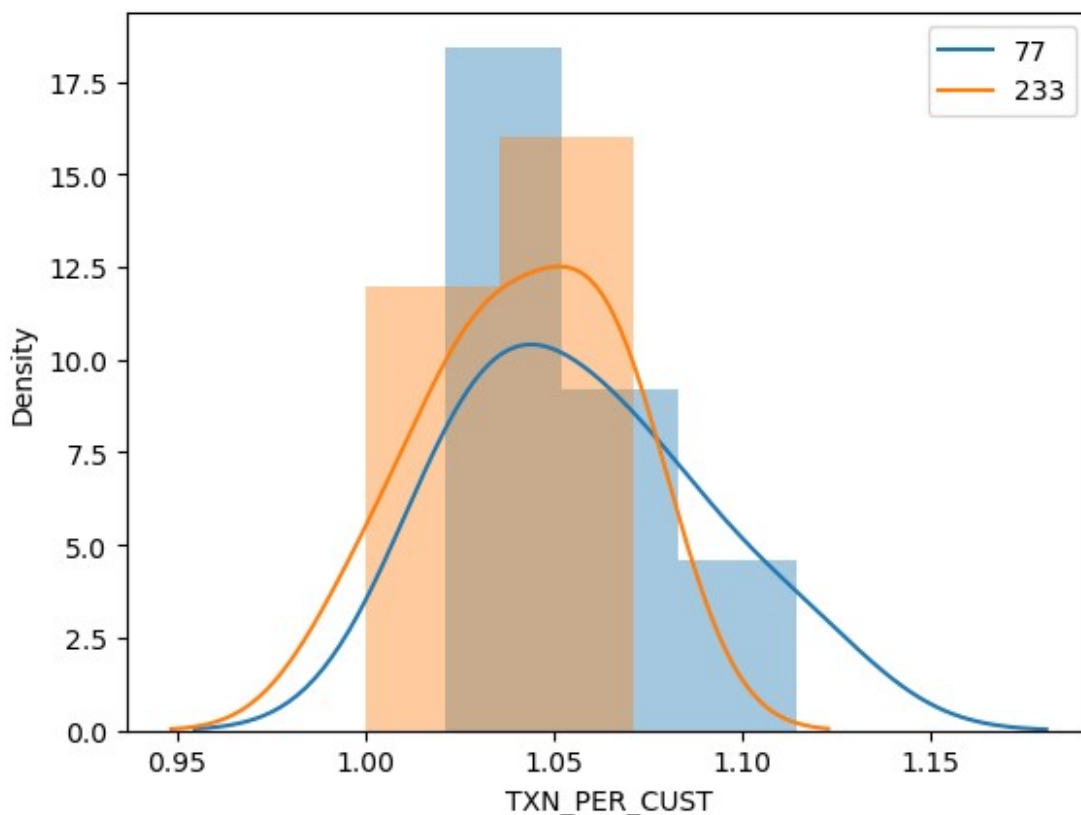
```python
from scipy.stats import ks_2samp,ttest_ind,t

# difference between control and trial sales
a=[]
for x in metrics.columns:
    a.append(ks_2samp(metrics.loc[77][x], metrics.loc[233][x]))
a=pd.DataFrame(a,index=metrics.columns)
a
```

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\1721721392.py:4:
RuntimeWarning:

ks_2samp: Exact calculation unsuccessful. Switching to method=asymp.

	statistic	pvalue
TOT_SALES	0.285714	0.962704
CUSTOMERS	0.142857	0.999961
PROD_QTY	0.285714	0.962704
PRICE_PER_UNIT	0.285714	0.962704
CHIP_PER_TXN	0.285714	0.962704
TXN_PER_CUST	0.428571	0.575175

```python
b=[]
for x in trial.columns:
    b.append(ttest_ind(trial.loc[77][x].tail(2), trial.loc[233]
```

```
[x].tail(2)))
b=pd.DataFrame(b,index=metrics.columns)
b
```

```
                statistic    pvalue
TOT_SALES        4.267336  0.050769
CUSTOMERS        2.586131  0.122618
PROD_QTY         4.043680  0.056063
PRICE_PER_UNIT  -0.634173  0.590828
CHIP_PER_TXN     1.785126  0.216165
TXN_PER_CUST     0.332434  0.771171
```

```
#critical value
t.ppf(0.95,df=7)
```

```
1.894578605061305
```

```
sns.distplot(trial.loc[77]['TOT_SALES'].tail(2))
sns.distplot(trial.loc[233]['TOT_SALES'].tail(2))
plt.legend(labels=['77','233'])
```

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\3423653171.py:1:
UserWarning:

`distplot` is a deprecated function and will be removed in seaborn
v0.14.0.

Please adapt your code to use either `displot` (a figure-level
function with
similar flexibility) or `histplot` (an axes-level function for
histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\3423653171.py:2:
UserWarning:

`distplot` is a deprecated function and will be removed in seaborn
v0.14.0.

Please adapt your code to use either `displot` (a figure-level
function with
similar flexibility) or `histplot` (an axes-level function for
histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

<matplotlib.legend.Legend at 0x1cf5c64f520>
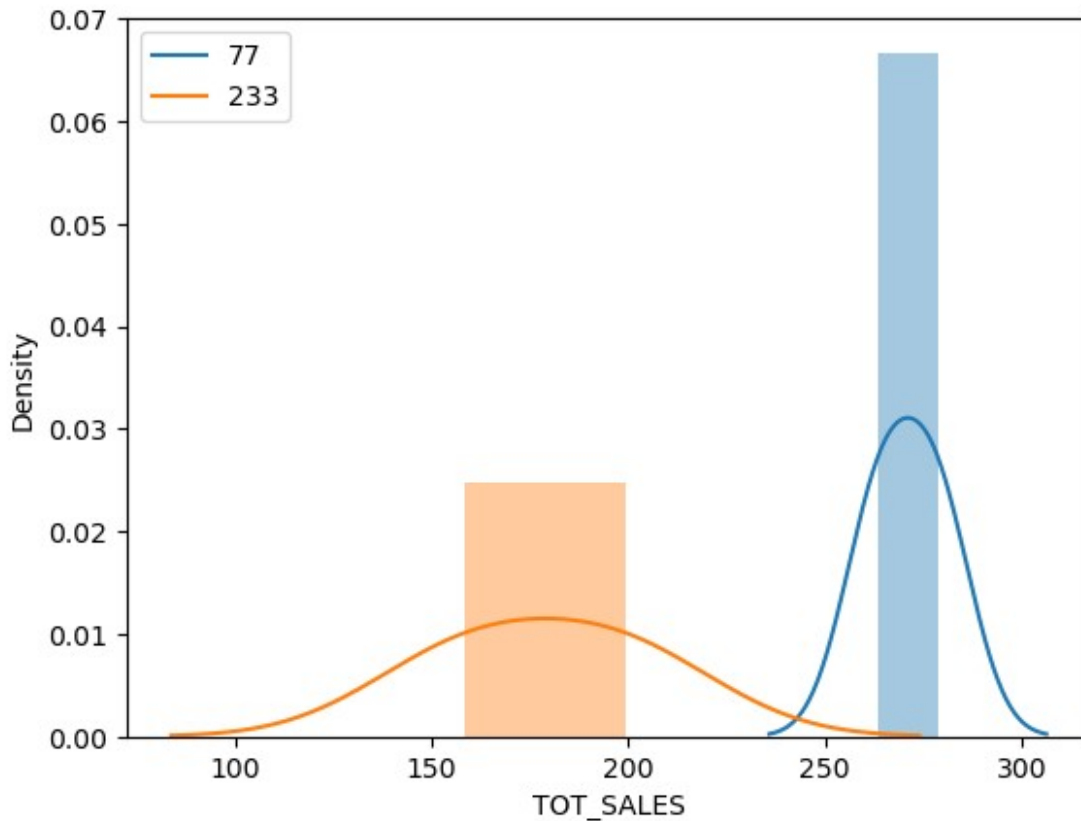

```python
sns.distplot(trial.loc[77]['CUSTOMERS'].tail(2))
sns.distplot(trial.loc[233]['CUSTOMERS'].tail(2))
plt.legend(labels=['77','233'])
```

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\1483174075.py:1:
UserWarning:

`distplot` is a deprecated function and will be removed in seaborn
v0.14.0.

Please adapt your code to use either `displot` (a figure-level
function with
similar flexibility) or `histplot` (an axes-level function for

histograms).

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https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\1483174075.py:2:
UserWarning:

`distplot` is a deprecated function and will be removed in seaborn
v0.14.0.

Please adapt your code to use either `displot` (a figure-level
function with
similar flexibility) or `histplot` (an axes-level function for
histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

<matplotlib.legend.Legend at 0x1cf5c4aea90>
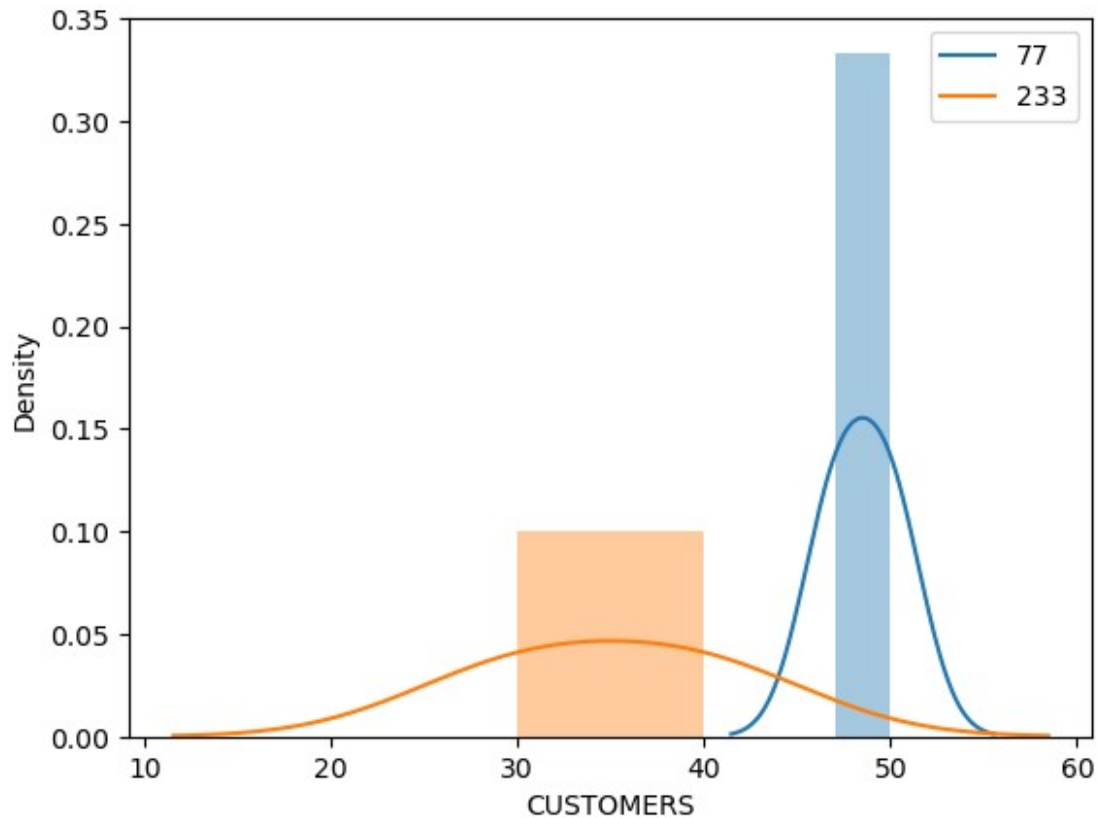
It can be visualized that the is a significant difference in the means, so trial store behavior(77) is different from control store (233).

The results show that the trial in store 77 is significantly different to its control store in the trial period as the trial store performance lies outside the 5% to 95% confidence interval of the control store in two of the three trial months.

Store 86
```
corr86=calcCorr(86)
corr86
```

	TOT_SALES	CUSTOMERS
STORE_NBR		
1	0.445632	0.485831
2	-0.403835	-0.086161
3	-0.261284	-0.353786
4	-0.039035	-0.169608
5	0.235159	-0.253229
...	...	...
268	-0.452182	-0.034273
269	0.697055	-0.098587
270	-0.730679	-0.767267
271	0.527637	0.267393
272	0.004926	-0.353815

```
[266 rows x 2 columns]

corr86=standardizer(corr86)
corr86

          TOT_SALES  CUSTOMERS  MAGNITUDE
STORE_NBR
1          0.445632   0.485831   0.465731
2          0.403835   0.086161   0.244998
3          0.261284   0.353786   0.307535
4          0.039035   0.169608   0.104322
5          0.235159   0.253229   0.244194
...             ...        ...        ...
268        0.452182   0.034273   0.243228
269        0.697055   0.098587   0.397821
270        0.730679   0.767267   0.748973
271        0.527637   0.267393   0.397515
272        0.004926   0.353815   0.179371

[266 rows x 3 columns]

corr86=corr86.sort_values(['MAGNITUDE'],ascending=False).dropna()
corr86

          TOT_SALES  CUSTOMERS  MAGNITUDE
STORE_NBR
86         1.000000   1.000000   1.000000
155        0.877882   0.942876   0.910379
23         0.784698   0.943559   0.864128
120        0.872693   0.815097   0.843895
114        0.734415   0.855339   0.794877
...             ...        ...        ...
91         0.019027   0.041271   0.030149
17         0.029793   0.030039   0.029916
131        0.028487   0.031142   0.029815
219        0.046653   0.004999   0.025826
234        0.010509   0.040306   0.025407

[263 rows x 3 columns]
```
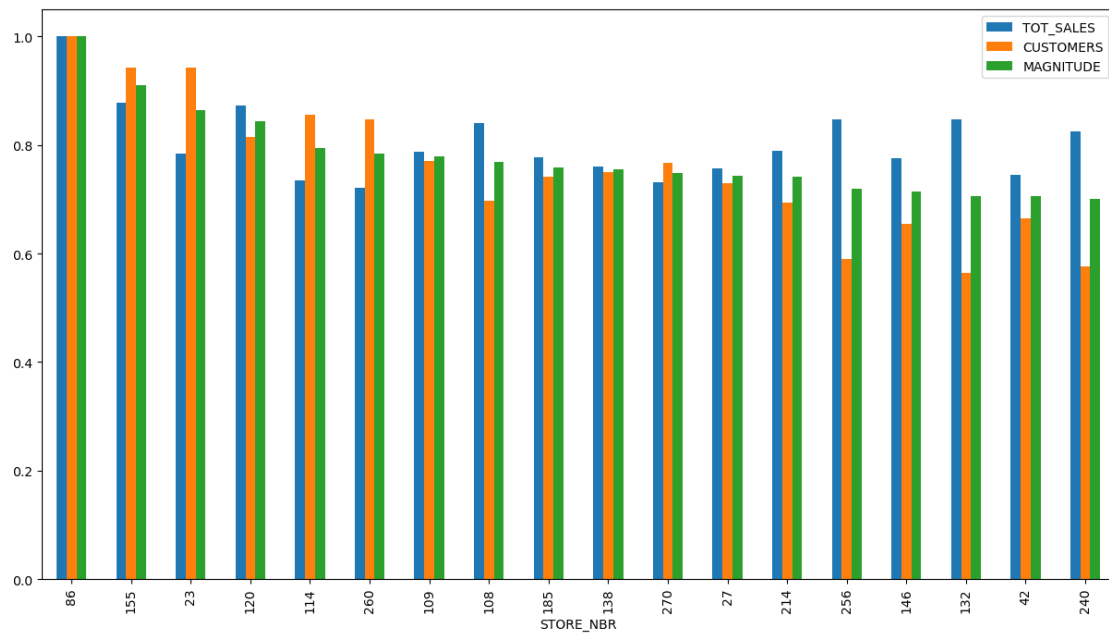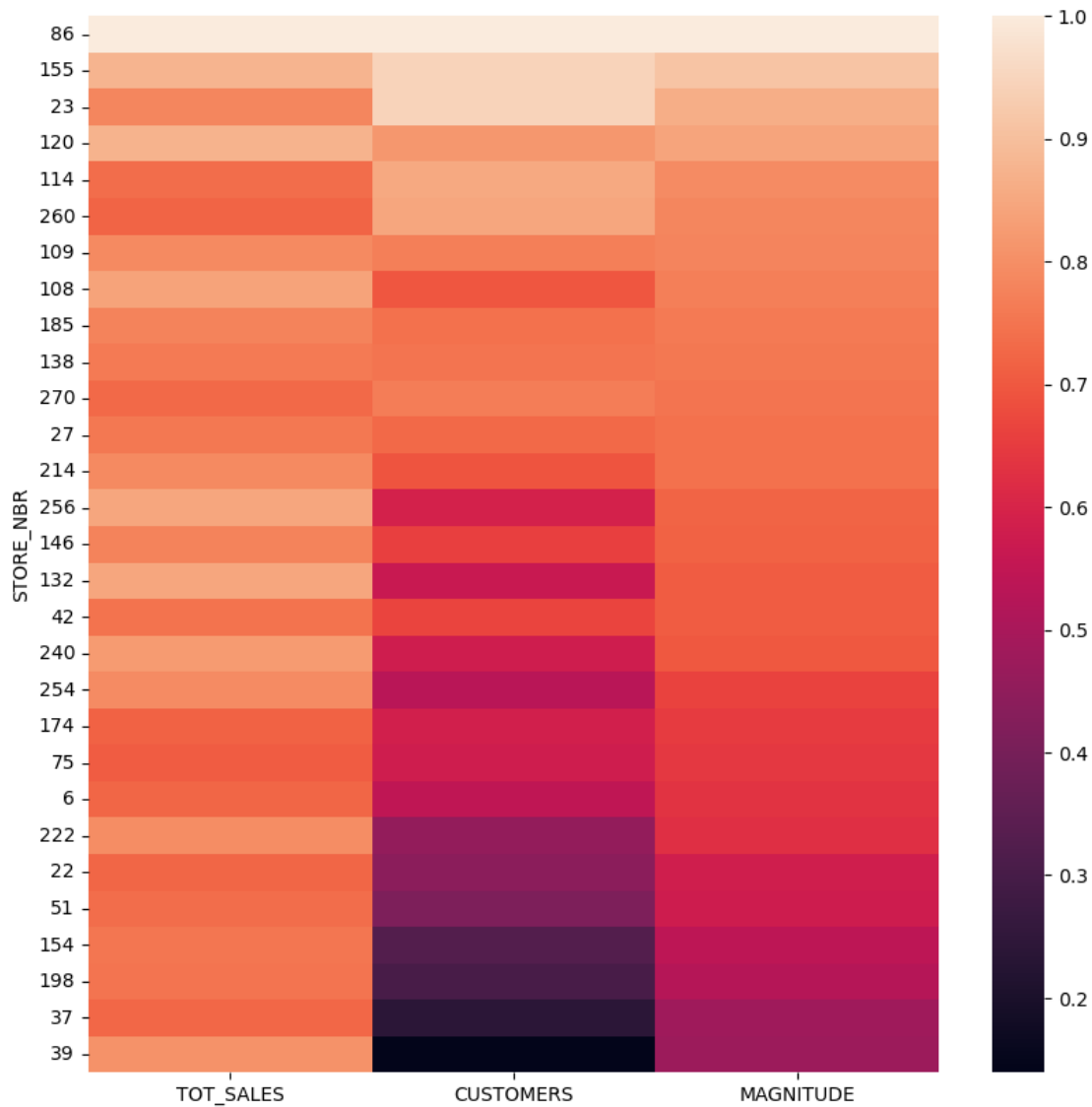
Visualizing
```
#Taking 0.7 as threshold corelation
corr86[(corr86.MAGNITUDE.abs()>0.7)].plot(kind='bar',figsize=(15,8))

<AxesSubplot: xlabel='STORE_NBR'>
```

```
plt.figure(figsize=(10,10))
sns.heatmap(corr86[corr86.TOT_SALES.abs()>0.7])
```

<AxesSubplot: ylabel='STORE_NBR'>

```
sns.distplot(metrics.loc[86]['TOT_SALES'])
sns.distplot(metrics.loc[155]['TOT_SALES'])
plt.legend(labels=['86','155'])
```

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\1112463217.py:1:
UserWarning:

`distplot` is a deprecated function and will be removed in seaborn
v0.14.0.

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function with
similar flexibility) or `histplot` (an axes-level function for
histograms).

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C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\1112463217.py:2:
UserWarning:

`distplot` is a deprecated function and will be removed in seaborn
v0.14.0.

Please adapt your code to use either `displot` (a figure-level
function with
similar flexibility) or `histplot` (an axes-level function for
histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

<matplotlib.legend.Legend at 0x1cf5d3d9fd0>
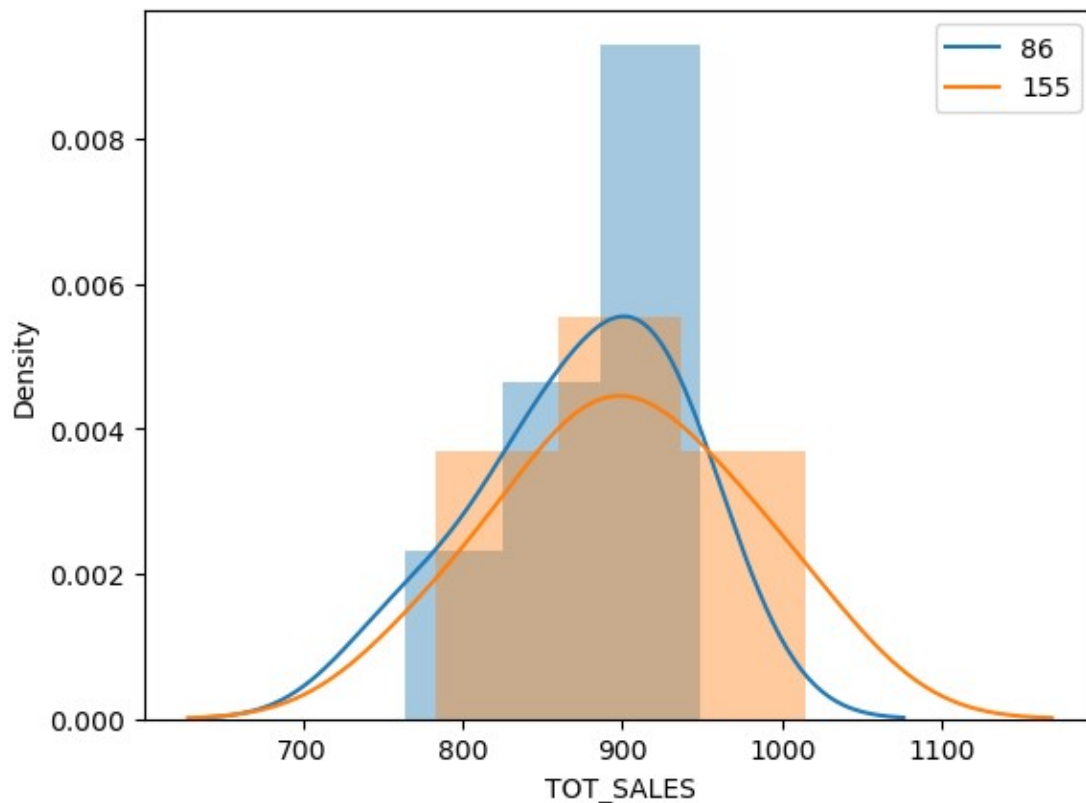
```
sns.distplot(metrics.loc[86]['CUSTOMERS'])
sns.distplot(metrics.loc[155]['CUSTOMERS'])
plt.legend(labels=['86','155'])
```

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\938361569.py:1:
UserWarning:

`distplot` is a deprecated function and will be removed in seaborn
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C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\938361569.py:2:
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https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751
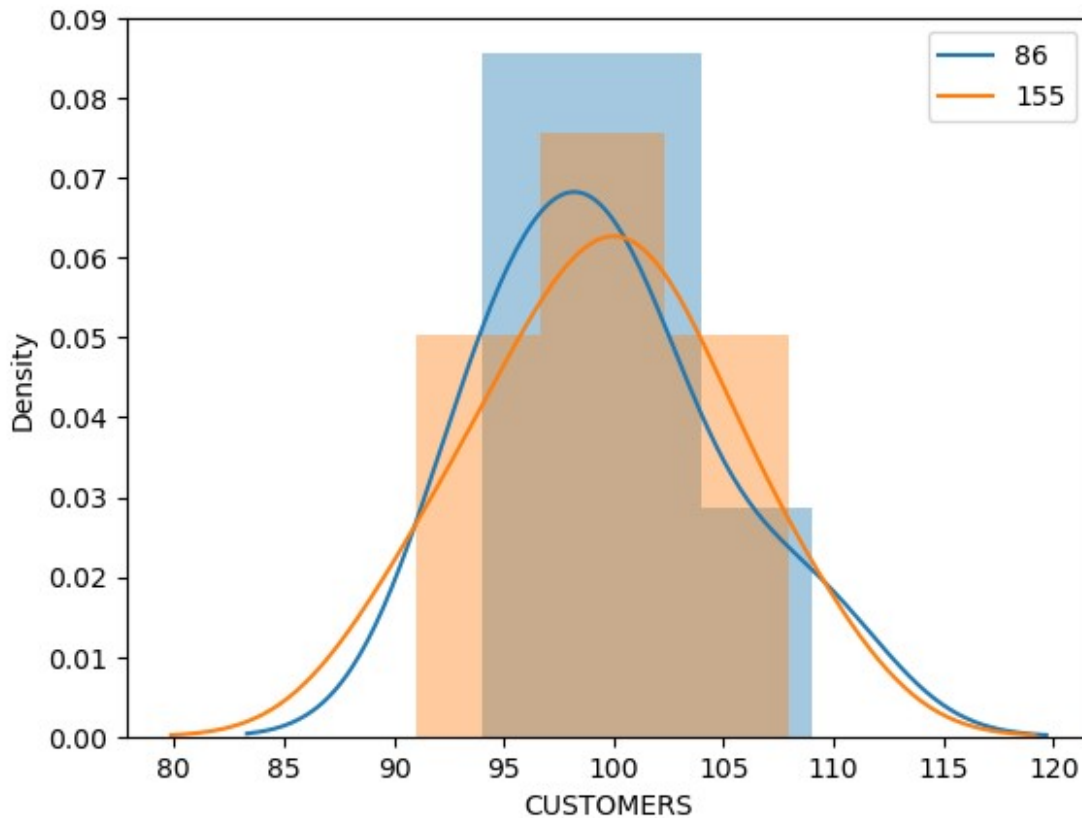
<matplotlib.legend.Legend at 0x1cf5cbe7f40>
```

```
sns.distplot(metrics.loc[86]['TXN_PER_CUST'])
sns.distplot(metrics.loc[155]['TXN_PER_CUST'])
plt.legend(labels=['86','155'])
```

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\999707.py:1:
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<matplotlib.legend.Legend at 0x1cf5ccfd1c0>


```
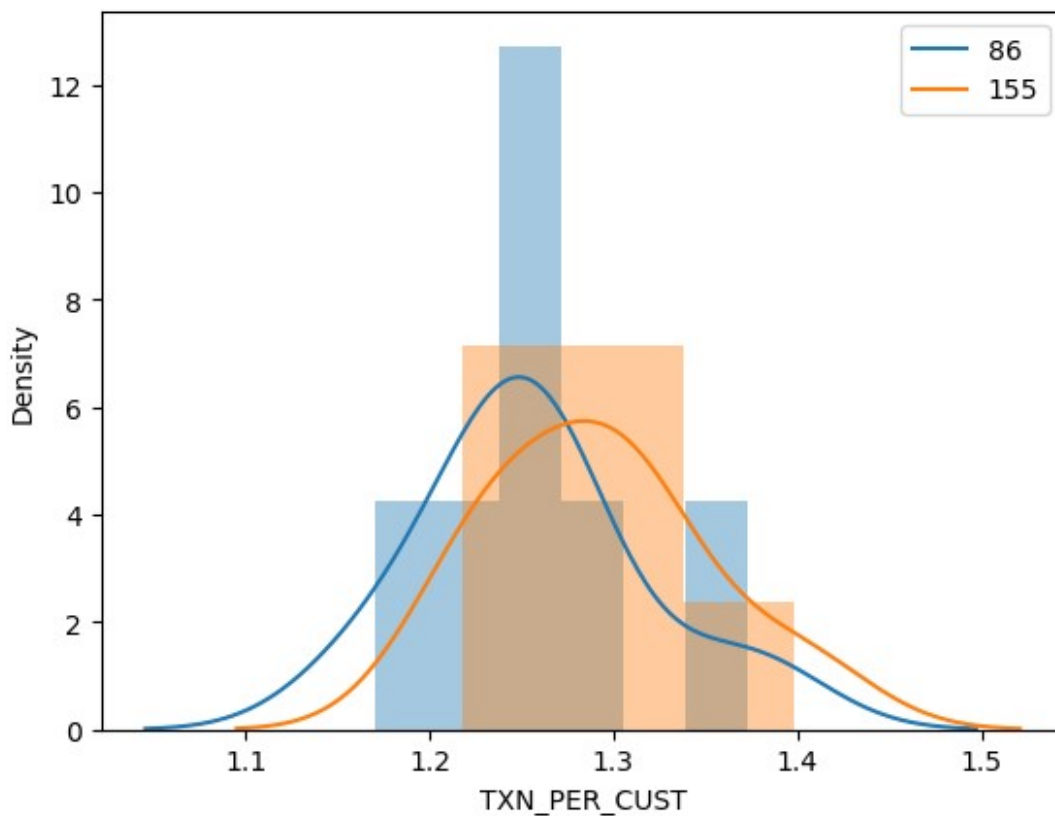sns.distplot(metrics.loc[86]['PROD_QTY'])
sns.distplot(metrics.loc[155]['PROD_QTY'])
plt.legend(labels=['86','155'])
```

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\1871391030.py:1:
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<matplotlib.legend.Legend at 0x1cf5cecfe20>

Since distributions of store 155 are similar to that of store 86, selecting store 155 as control store with max similarities to store 86

Calculating difference between scaled control sales and trial sales

```python
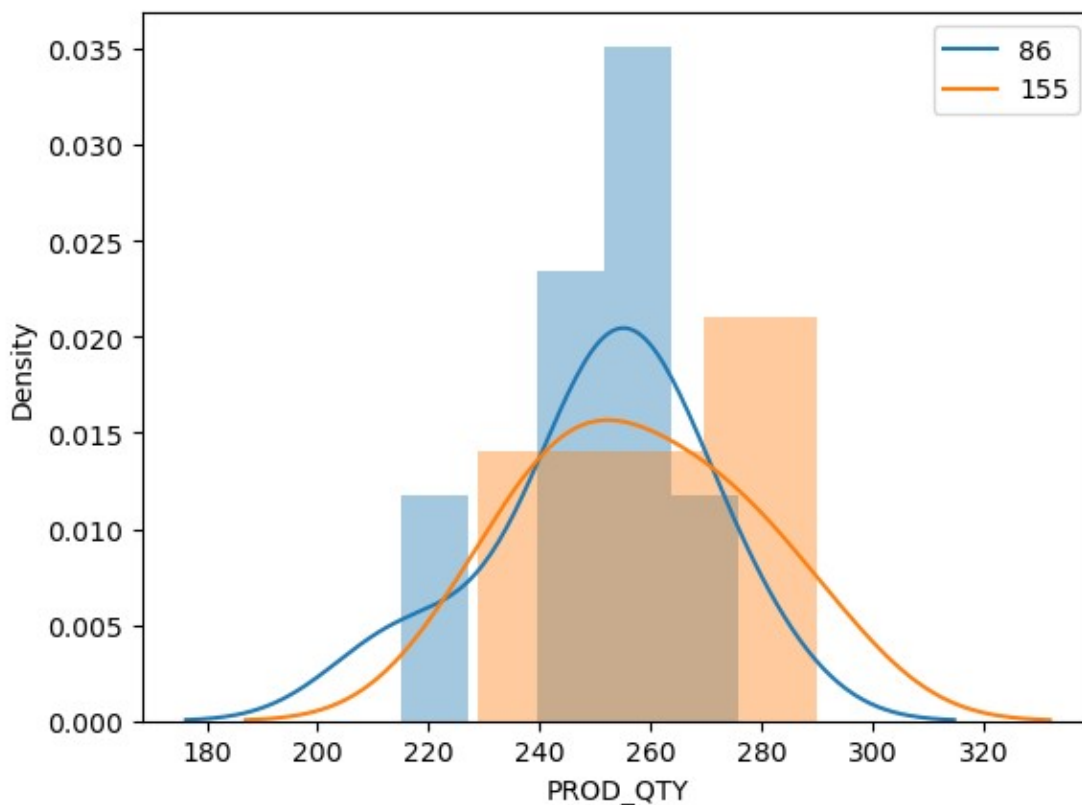from scipy.stats import ks_2samp,ttest_ind,ttest_rel,t
# difference between control and trial sales
a=[]
for x in metrics.columns:
    a.append(ks_2samp(metrics.loc[86][x], metrics.loc[155][x]))
a=pd.DataFrame(a,index=metrics.columns)
a
```

```
                statistic    pvalue
TOT_SALES        0.285714  0.962704
CUSTOMERS        0.285714  0.962704
PROD_QTY         0.285714  0.962704
PRICE_PER_UNIT   0.428571  0.575175
CHIP_PER_TXN     0.428571  0.575175
TXN_PER_CUST     0.428571  0.575175
```

For pre trial period, since p-values for TOT_SALES, CUSTOMERS and PROD_QTY are high (say more than 0.95), we can't reject the null hypothesis

Assessment of trial

```python
b=[]
for x in trial.columns:
    b.append(ttest_ind(trial.loc[86][x].tail(2), trial.loc[155]
[x].tail(2)))
b=pd.DataFrame(b,index=metrics.columns)
b
```

	statistic	pvalue
TOT_SALES	1.234512	0.342378
CUSTOMERS	2.414953	0.137076
PROD_QTY	1.862532	0.203568
PRICE_PER_UNIT	0.366214	0.749316
CHIP_PER_TXN	-0.285938	0.801822
TXN_PER_CUST	-1.074767	0.394929

```python
#critical value
t.ppf(0.95,df=7)
```

```
1.894578605061305
```

Since all of the p-values are high (say more than 0.05), we reject the null hypothesis i.e. there means are significantly different. We can observe that the t-value is much larger than the 95th percentile value of the t-distribution for March and April - i.e. the increase in sales in the trial store in March and April is statistically greater than in the control store.

The results show that the trial in store 88 is significantly different to its control store in the trial period as the trial store performance lies outside of the 5% to 95% confidence interval of the control store in two of the three trial months.

```python
sns.distplot(trial.loc[86]['TOT_SALES'].tail(2))
sns.distplot(trial.loc[155]['TOT_SALES'].tail(2))
plt.legend(labels=['86','155'])
```

```
C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\495834011.py:1:
UserWarning:


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```

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<matplotlib.legend.Legend at 0x1cf5cecf760>

```
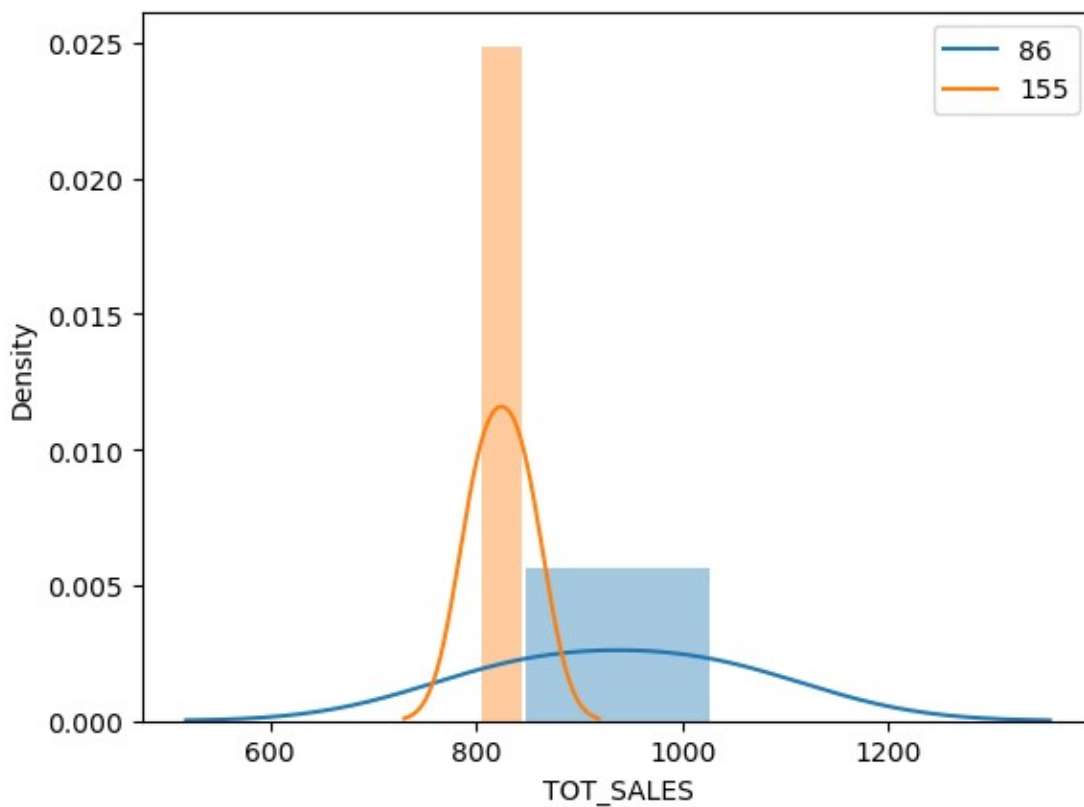sns.distplot(trial.loc[86]['CUSTOMERS'].tail(2))
sns.distplot(trial.loc[155]['CUSTOMERS'].tail(2))
plt.legend(labels=['86','155'])
```

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\3682141979.py:1:
UserWarning:

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<matplotlib.legend.Legend at 0x1cf5cfa5940>
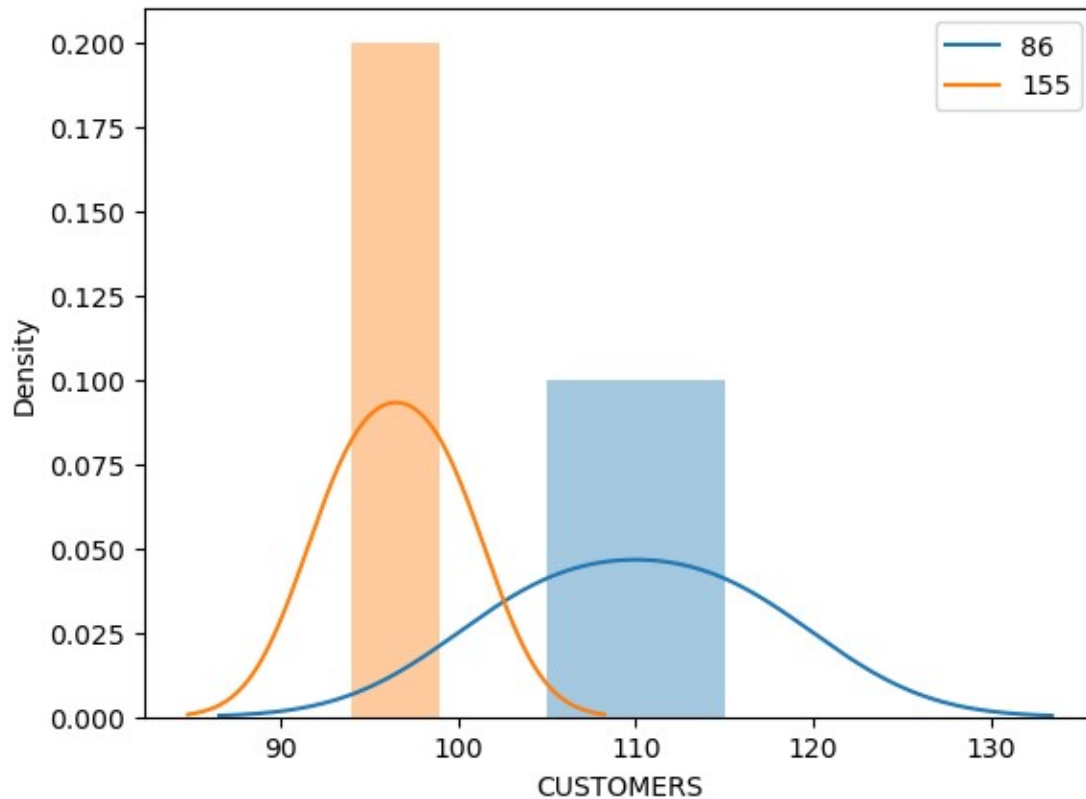
It can be visualized that the is a significant difference in the means, so trial store behavior(86) is different from control store (155).

It looks like the number of customers is significantly higher in all of the three months. This seems to suggest that the trial had a significant impact on increasingthe number of customers in trial store 86 but as we saw, sales were not significantly higher. We should check with the Category Manager if there were special deals in the trial store that were may have resulted in lower prices, impacting the results.

Store 88

```
corr88=calcCorr(88)
corr88.head()
```

```
           TOT_SALES   CUSTOMERS
STORE_NBR
1           0.813636    0.305334
2          -0.067927   -0.452379
3          -0.507847    0.522884
4          -0.745566   -0.361503
5           0.190330   -0.025320
```

```
corr88=standardizer(corr88)
corr88
```

```
           TOT_SALES   CUSTOMERS   MAGNITUDE
STORE_NBR
1           0.813636    0.305334    0.559485
2           0.067927    0.452379    0.260153
3           0.507847    0.522884    0.515365
4           0.745566    0.361503    0.553534
5           0.190330    0.025320    0.107825

...              ...         ...         ...
268         0.021429    0.672672    0.347050
269         0.172578    0.274781    0.223679
270         0.723272    0.103032    0.413152
271         0.103037    0.018831    0.060934
272         0.772772    0.026909    0.399841

[265 rows x 3 columns]
```

```python
corr88=corr88.sort_values(['MAGNITUDE'],ascending=False).dropna()
corr88.head()
```

```
           TOT_SALES   CUSTOMERS   MAGNITUDE
STORE_NBR
88          1.000000    1.000000    1.000000
178         0.731857    0.939466    0.835661
14          0.698557    0.942976    0.820767
133         0.735407    0.835426    0.785417
204         0.885774    0.550263    0.718018
```

Visualizing

```python
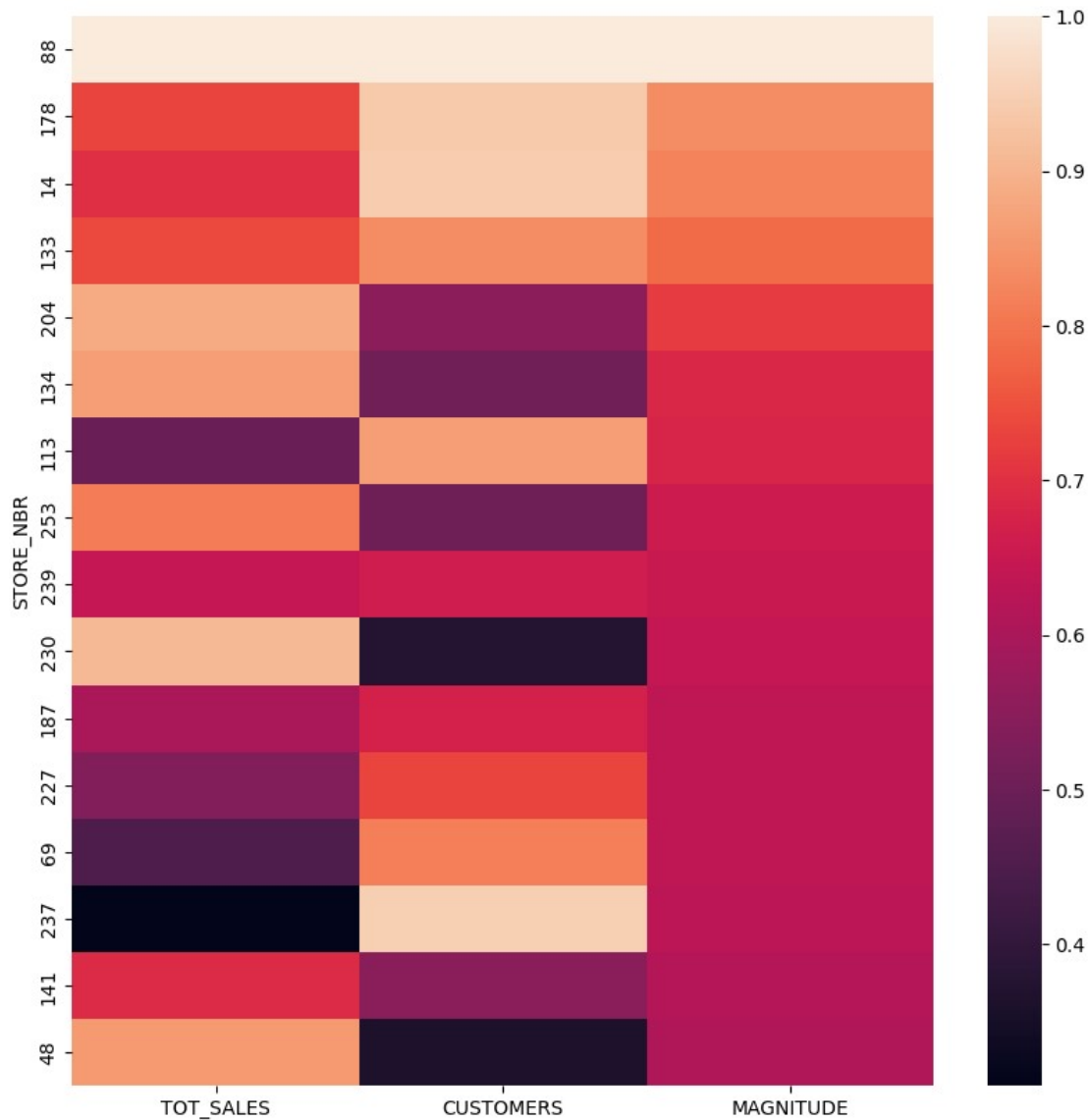#Taking 0.6 as threshold corelation
corr88[(corr88.MAGNITUDE.abs()>0.6)].plot(kind='bar',figsize=(15,8))
```

```
<AxesSubplot: xlabel='STORE_NBR'>
```
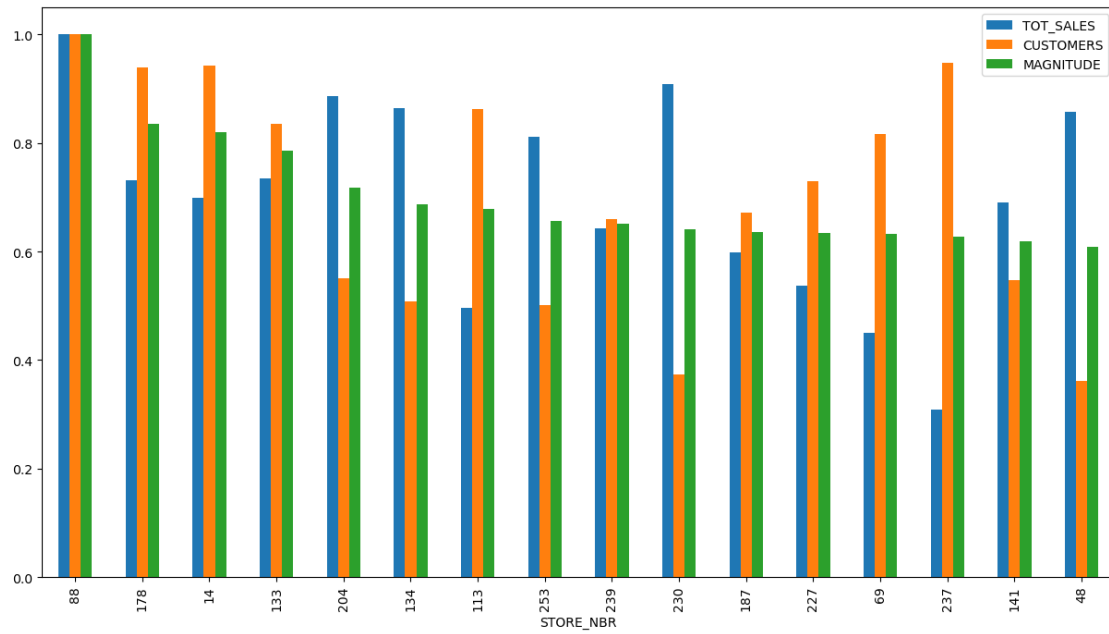
```
plt.figure(figsize=(10,10))
sns.heatmap(corr88[corr88.MAGNITUDE.abs()>0.6])
```

<AxesSubplot: ylabel='STORE_NBR'>

```
plt.figure(figsize=(15,10))
for x in corr88[corr88.MAGNITUDE.abs()>0.6].index:
    sns.distplot(metrics.loc[88]['TOT_SALES'])
    sns.distplot(metrics.loc[x]['TOT_SALES'],label=x,hist=False)
plt.legend()
```

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Please adapt your code to use either `displot` (a figure-level
function with
similar flexibility) or `histplot` (an axes-level function for
histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\3816158040.py:4:
UserWarning:

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v0.14.0.

Please adapt your code to use either `displot` (a figure-level
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similar flexibility) or `kdeplot` (an axes-level function for kernel
density plots).

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C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\3816158040.py:3:
UserWarning:

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v0.14.0.

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C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\3816158040.py:4:
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C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\3816158040.py:4:
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https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

<matplotlib.legend.Legend at 0x1cf5d5889a0>


```python
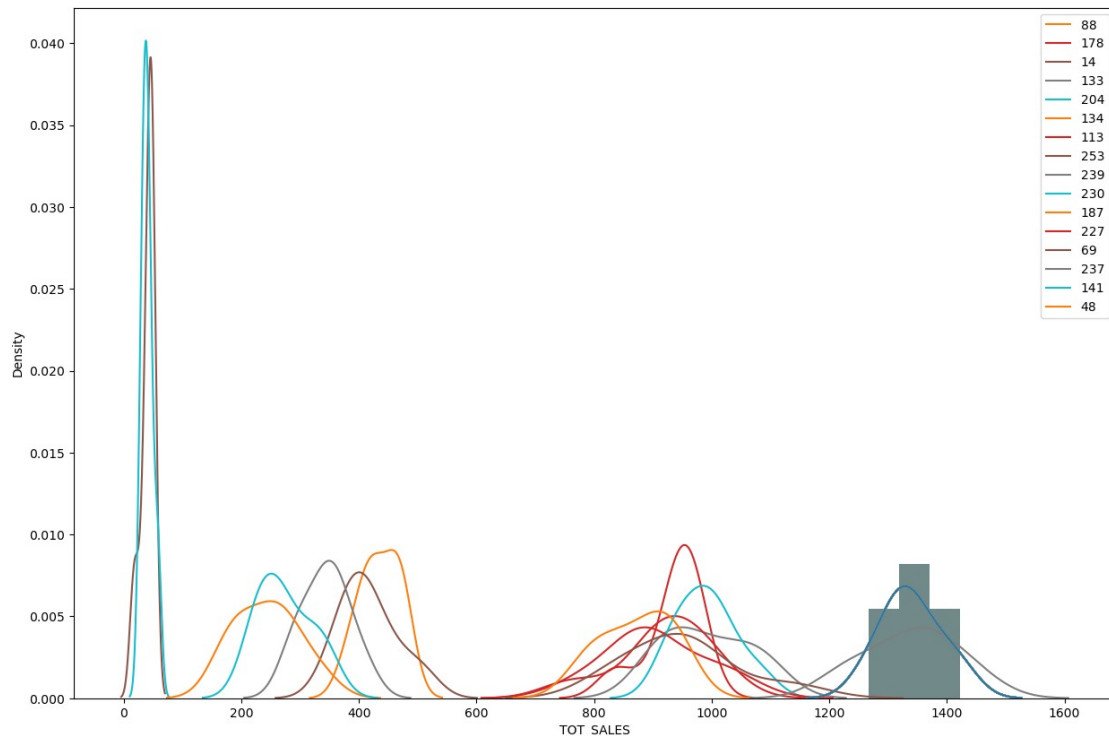sns.distplot(metrics.loc[88]['TOT_SALES'])
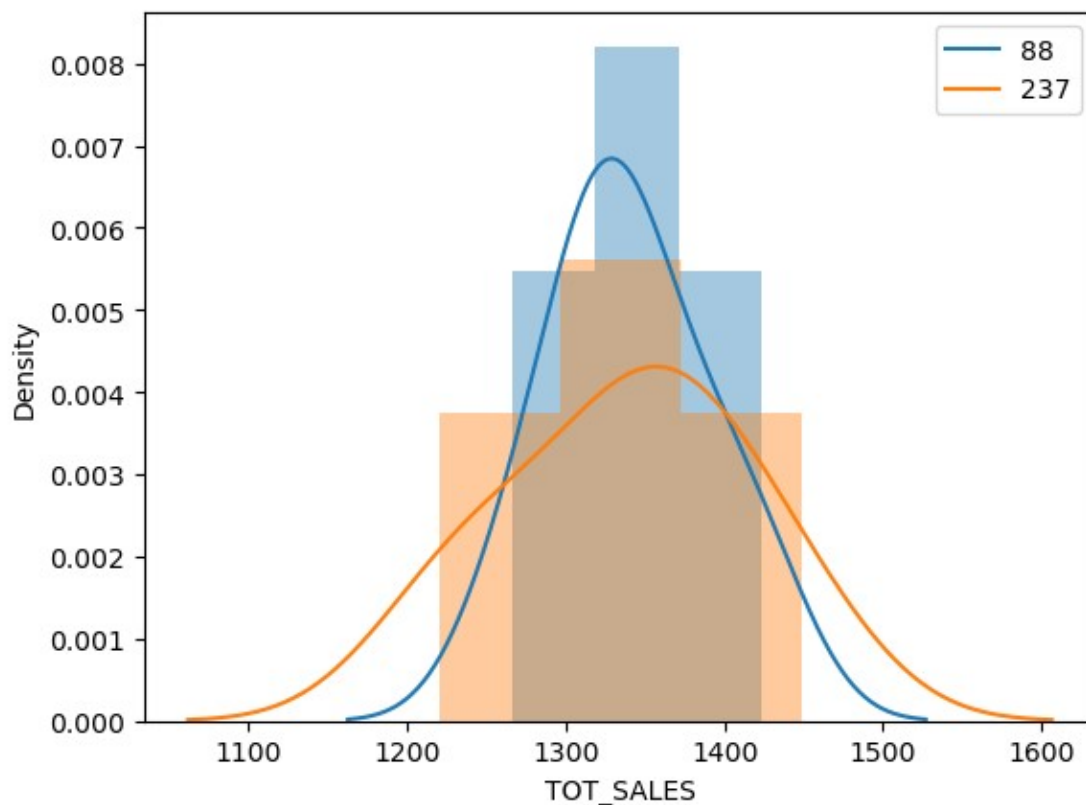sns.distplot(metrics.loc[237]['TOT_SALES'])
plt.legend(labels=['88','237'])
```

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\2629689805.py:1:
UserWarning:

`distplot` is a deprecated function and will be removed in seaborn
v0.14.0.

Please adapt your code to use either `displot` (a figure-level
function with
similar flexibility) or `histplot` (an axes-level function for
histograms).

<matplotlib.legend.Legend at 0x1cf5d581be0>

```
sns.distplot(metrics.loc[88]['CUSTOMERS'])
sns.distplot(metrics.loc[237]['CUSTOMERS'])
plt.legend(labels=['88','237'])
```

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\132821773.py:1:
UserWarning:

`distplot` is a deprecated function and will be removed in seaborn
v0.14.0.

Please adapt your code to use either `displot` (a figure-level
function with
similar flexibility) or `histplot` (an axes-level function for
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https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\132821773.py:2:
UserWarning:

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v0.14.0.

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function with
similar flexibility) or `histplot` (an axes-level function for
histograms).

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https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

<matplotlib.legend.Legend at 0x1cf5d691a30>

```
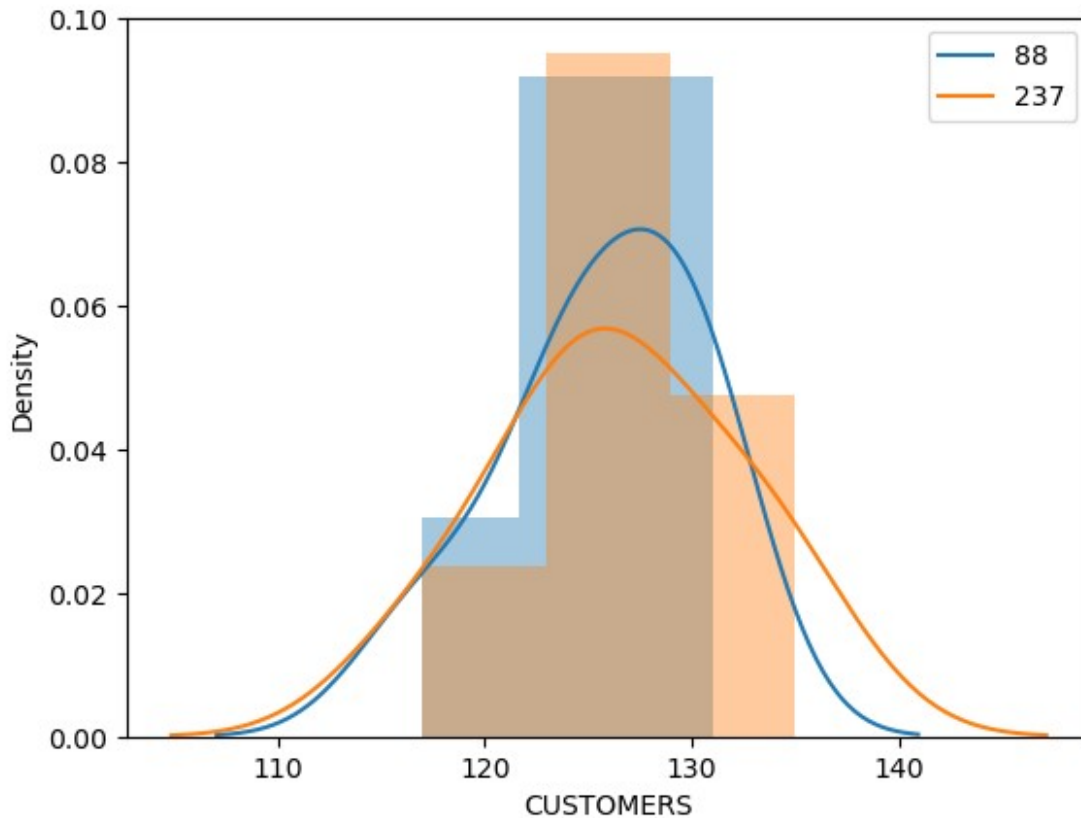sns.distplot(metrics.loc[88]['TXN_PER_CUST'])
sns.distplot(metrics.loc[237]['TXN_PER_CUST'])
plt.legend(labels=['88','237'])
```

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\3550943983.py:1:
UserWarning:

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v0.14.0.

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similar flexibility) or `histplot` (an axes-level function for
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C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\3550943983.py:2:
UserWarning:

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similar flexibility) or `histplot` (an axes-level function for
histograms).

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<matplotlib.legend.Legend at 0x1cf5d89b790>

*Since distributions of store 237 are similar to that of store 88, selecting store 237 as control
store with max similarities to store 88*

Calculating difference between scaled control sales and trial sales

```python
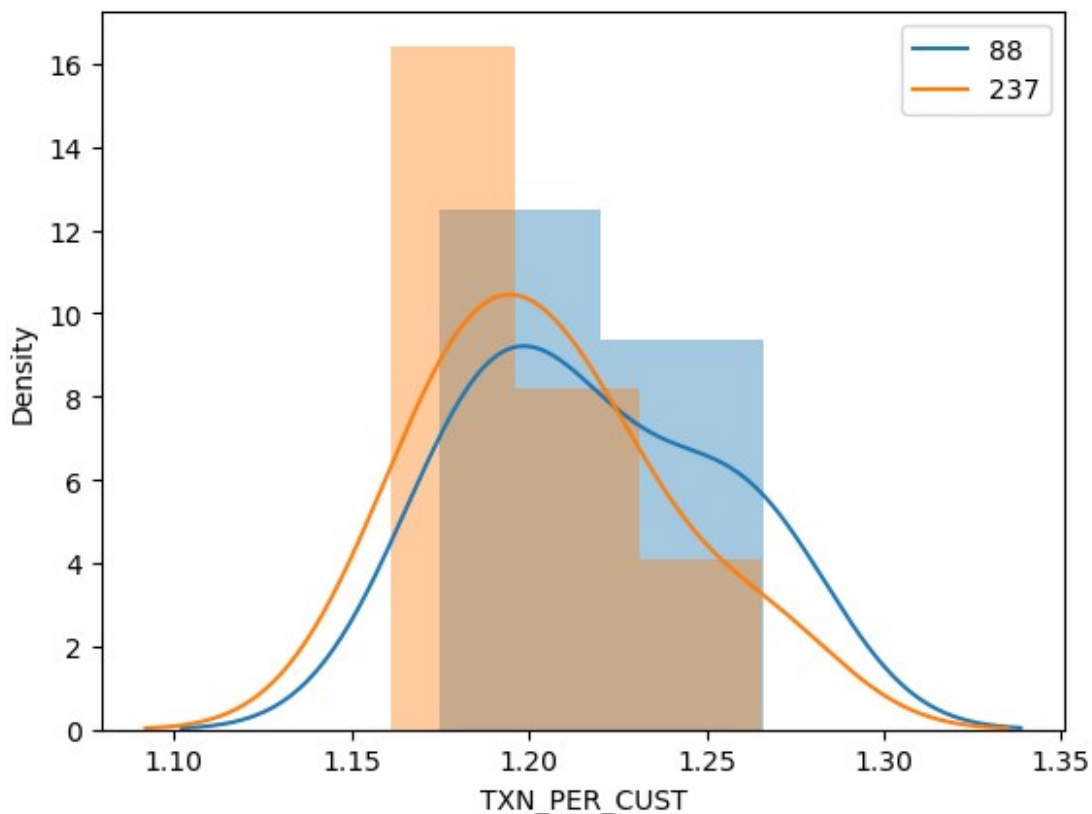from scipy.stats import ks_2samp,ttest_ind,t
# difference between control and trial sales
a=[]
```

```python
for x in metrics.columns:
    a.append(ks_2samp(metrics.loc[88][x], metrics.loc[237][x]))
a=pd.DataFrame(a,index=metrics.columns)
a
```

	statistic	pvalue
TOT_SALES	0.285714	0.962704
CUSTOMERS	0.285714	0.962704
PROD_QTY	0.285714	0.962704
PRICE_PER_UNIT	0.428571	0.575175
CHIP_PER_TXN	0.571429	0.212121
TXN_PER_CUST	0.285714	0.962704

```python
b=[]
for x in trial.columns:
    b.append(ttest_ind(trial.loc[86][x].tail(2), trial.loc[237]
[x].tail(2)))
b=pd.DataFrame(b,index=metrics.columns)
b
```

	statistic	pvalue
TOT_SALES	-3.010587	0.094888
CUSTOMERS	-1.890571	0.199245
PROD_QTY	-0.266076	0.815100
PRICE_PER_UNIT	-6.804115	0.020925
CHIP_PER_TXN	-0.465456	0.687370
TXN_PER_CUST	9.547202	0.010794

```python
#critical value
t.ppf(0.95,df=7)
```

1.894578605061305

```python
sns.distplot(trial.loc[88]['TOT_SALES'].tail(2))
sns.distplot(trial.loc[237]['TOT_SALES'].tail(2))
plt.legend(labels=['88','237'])
```

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\3345218753.py:1:
UserWarning:

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similar flexibility) or `histplot` (an axes-level function for
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C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\3345218753.py:2:
UserWarning:

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v0.14.0.

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For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

<matplotlib.legend.Legend at 0x1cf5e5c6a00>

```
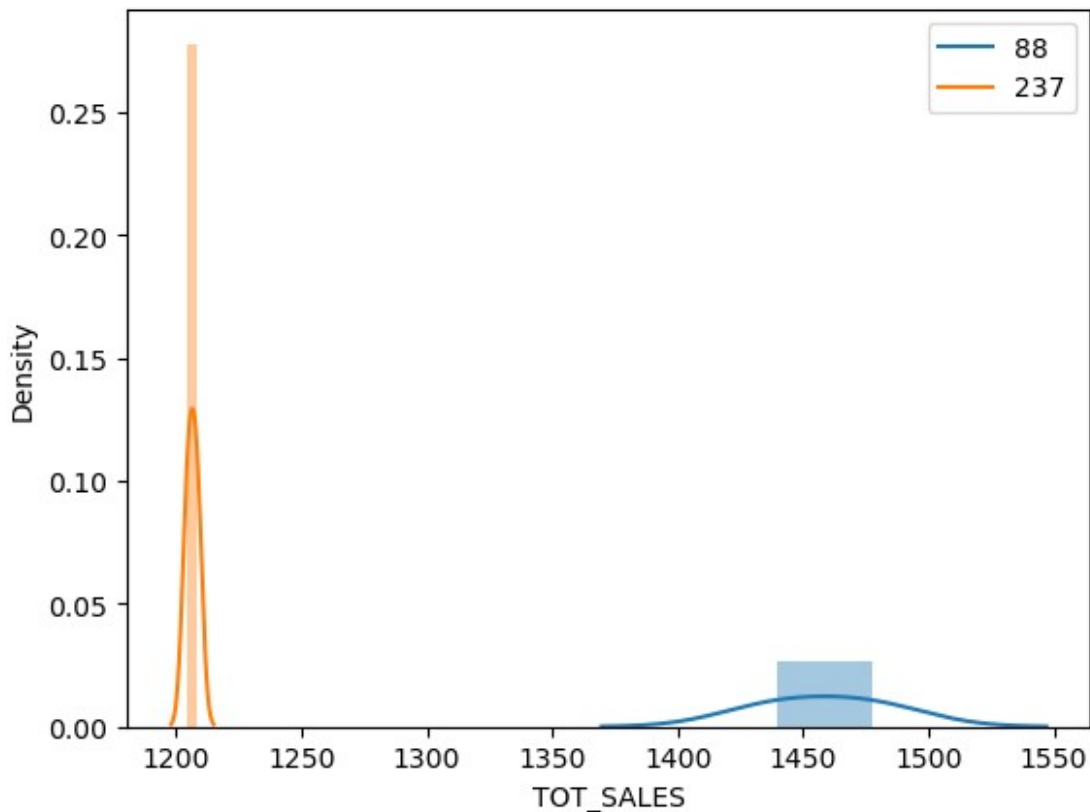sns.distplot(trial.loc[88]['CUSTOMERS'].tail(2))
sns.distplot(trial.loc[237]['CUSTOMERS'].tail(2))
plt.legend(labels=['88','237'])
```

C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\1775249445.py:1:
UserWarning:

`distplot` is a deprecated function and will be removed in seaborn
v0.14.0.

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similar flexibility) or `histplot` (an axes-level function for
histograms).

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C:\Users\Preeti\AppData\Local\Temp\ipykernel_4964\1775249445.py:2:
UserWarning:

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https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

<matplotlib.legend.Legend at 0x1cf5e634070>
```
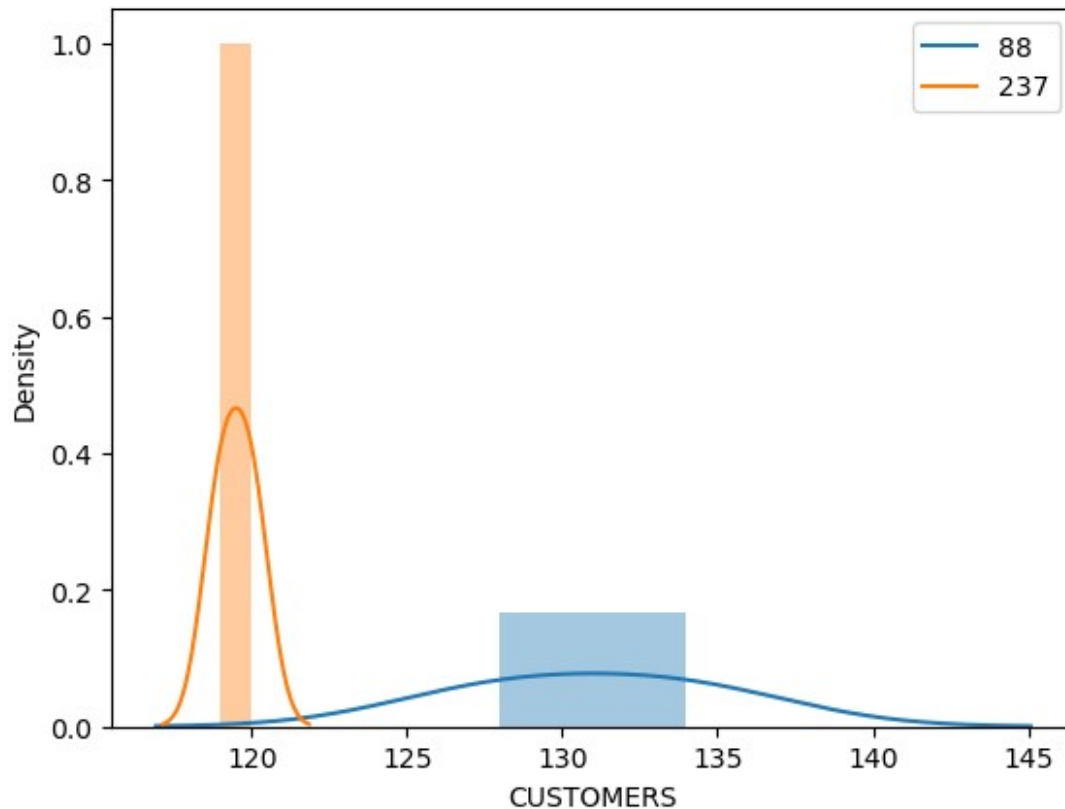
**It can be visualized that the is a significant difference in the means, so trial store behavior(88) is different from control store (237).**

*Total number of customers in the trial period for the trial store is significantly higher than the control store for two out of three months, which indicates a positive trial effect.*

```python
fig, ax = plt.subplots(figsize=(15, 8))
x=['77','88','86','253','155','237']
for i in  x:

    sns.lineplot(data=full.loc[int(i)],y='TOT_SALES',x=full.index.get_leve
    l_values(1).unique(),label=i)


#ax.set_xlim(201807,201812)
ax.set_xlim(201901,201906)
```

```
(201901.0, 201906.0)
```
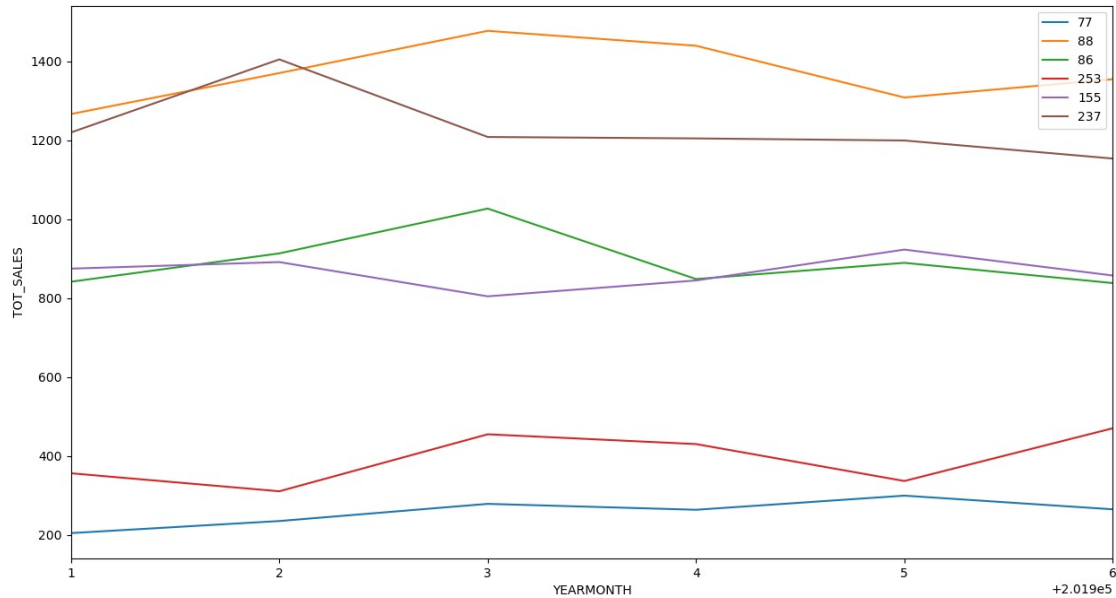
Conclusion

The results for trial stores 77 and 88 during the trial period show a significant difference in at least two of the three trial months but this is not the case for trial store 86. We can check with the client if the implementation of the trial was different in trial store 86 but overall, the trial shows a significant increase in sales.