Quantium Virtual Internship

Task 2

Importing required libraries

In [1]:

```
import pandas as pd
import numpy as np
import inspect, os, sys
import pickle
import matplotlib.pyplot as plt
from matplotlib import style
style.use('ggplot')

from IPython.core.display import display, HTML
display(HTML("<style>.rendered_html td { white-space: pre; }</style>"))

sys.path.append('C://Users//Dhruv Sharma//AppData//Local//Programs//Python//Python37//Lib//site-packages')
```

Getting the data

In [2]:

```
def store_df():
    script_path = inspect.getfile(inspect.currentframe())
    script_dir = os.path.dirname(os.path.abspath(script_path))
    data = pd.read_csv(os.path.join(script_dir, "QVI_data.csv"))
    with open('df.pickle', 'wb') as f:
        pickle.dump(data, f)

def get_df():
    with open('df.pickle', 'rb') as f:
        df = pickle.load(f)
        return df

if not os.path.exists('df.pickle'):
    store_df()
data = get_df()
```

Creating the metrics

In [3]:

```
s = data['DATE'].str.split('-')
yearmonth = (s.apply(lambda r:''.join(r[0:2]))).astype('int32')
data['YEARMONTH'] = yearmonth

stores_monthly = data.groupby(['STORE_NBR','YEARMONTH'])
measureOverTime = pd.DataFrame(data=stores_monthly['TOT_SALES'].sum())
measureOverTime.columns = ['totSales']
measureOverTime['nCustomers'] = stores_monthly['LYLTY_CARD_NBR'].nunique()
measureOverTime['nTxnPerCust'] = stores_monthly['TXN_ID'].nunique() / measureOverTime['nCustomers']
measureOverTime['nChipsPerTxn'] = stores_monthly['PROD_QTY'].sum() / stores_monthly['TXN_ID'].nunique()
measureOverTime['avgPricePerUnit'] = measureOverTime['totSales'] / stores_monthly['PROD_QTY'].sum()
measureOverTime.reset_index(inplace=True)
```

Filter to the pre-trial period

In [ ]:

In [4]:

```
preTrial = measureOverTime.loc[(measureOverTime['YEARMONTH'] < 201902), :]
stores = preTrial.groupby('STORE_NBR')['YEARMONTH'].count() == 7 #there are 7 months in the pre-tri
al period
storesWithFullObs = stores[stores == True].index
preTrialMeasures = measureOverTime.loc[(measureOverTime['YEARMONTH'] < 201902) &
                                       (measureOverTime['STORE_NBR'].isin(storesWithFullObs)), :]
preTrialMeasures
```

Out[4]:

	STORE_NBR	YEARMONTH	totSales	nCustomers	nTxnPerCust	nChipsPerTxn	avgPricePerUnit
0	1	201807	206.9	49	1.061224	1.192308	3.337097
1	1	201808	176.1	42	1.023810	1.255814	3.261111
2	1	201809	278.8	59	1.050847	1.209677	3.717333
3	1	201810	188.1	44	1.022727	1.288889	3.243103
4	1	201811	192.6	46	1.021739	1.212766	3.378947
...	...	...	...	...	...	...	...
3159	272	201809	304.7	32	1.125000	1.972222	4.291549
3160	272	201810	430.6	44	1.136364	1.980000	4.349495
3161	272	201811	376.2	41	1.097561	1.933333	4.324138
3162	272	201812	403.9	47	1.000000	1.893617	4.538202
3163	272	201901	423.0	46	1.086957	1.920000	4.406250

1820 rows × 7 columns

Function to calculate correlation

In [5]:

```
def cal_corr(storeComparison, metricCol):
    corrTable = pd.DataFrame()
    store1 = preTrialMeasures.loc[preTrialMeasures['STORE_NBR']==storeComparison, metricCol]
    store1.reset_index(drop=True, inplace=True)

    for store in preTrialMeasures['STORE_NBR'].unique():
        store2 = preTrialMeasures.loc[preTrialMeasures['STORE_NBR']==store, metricCol]
        store2.reset_index(drop=True, inplace=True)
        calculatedMeasure = store1.corr(store2)
        corrTable = corrTable.append(pd.Series([storeComparison, store, calculatedMeasure]), ignore
_index=True)

    corrTable.columns=['Store1', 'Store2', 'corr_measure']
    corrTable = corrTable.astype({'Store1':'int32', 'Store2':'int32'})
    return corrTable.sort_values('corr_measure', ascending=False).reset_index(drop=True)
```

Function to calculate a standardised magnitude distance measure

In [6]:

```
def calculateMagnitudeDistance(storeComparison, metricCol):
    distTable = pd.DataFrame()
    storeYearMonths = list(preTrialMeasures.groupby(['STORE_NBR', 'YEARMONTH']).groups.keys())

    for storeYearMonth in storeYearMonths:
        otherStore, yearMonth = storeYearMonth
        obs1 = preTrialMeasures.loc[(preTrialMeasures['STORE_NBR'] == storeComparison) &
                                    (preTrialMeasures['YEARMONTH'] == yearMonth), metricCol]
        obs2 = preTrialMeasures.loc[(preTrialMeasures['STORE_NBR'] == otherStore) &
                                     (preTrialMeasures['YEARMONTH'] == yearMonth), metricCol]
        calculatedMeasure = abs(obs1.values[0] - obs2.values[0])
        distTable = distTable.append(pd.Series([storeComparison, otherStore, yearMonth, calculatedM
easure]),
                                     ignore_index=True)
```

```
    distTable.columns=['Store1', 'Store2', 'YEARMONTH', 'measure']
    distTable = distTable.astype({'Store1':'int32', 'Store2':'int32', 'YEARMONTH':'int64'})
    distTable.reset_index(inplace=True, drop=True)

    #Standardise the magnitude distance so that the measure ranges from 0 to 1
    minDist = distTable['measure'].min()
    maxDist = distTable['measure'].max()
    distTable['measure'] = 1 - ((distTable['measure'] - minDist) / (maxDist - minDist))

    finalDistTable = pd.DataFrame(distTable.groupby('Store2')['measure'].mean()).reset_index()
    finalDistTable.insert(0, 'Store1', storeComparison, True)
    return finalDistTable.sort_values('measure', ascending=False).reset_index(drop=True)
```

Getting and combining all the scores

In [7]:

```
def get_score_Control(trial_store):
    corr_nSales = cal_corr(trial_store, 'totSales')
    corr_nCustomers = cal_corr(trial_store, 'nCustomers')
    magnitude_nSales = calculateMagnitudeDistance(trial_store, 'totSales')
    magnitude_nCustomers = calculateMagnitudeDistance(trial_store, 'nCustomers')

    corr_weight = 0.5
    score_nSales = corr_nSales.merge(magnitude_nSales, how='inner', on=['Store1', 'Store2'])
    score_nSales['scoreNSales'] = ((score_nSales['corr_measure']*corr_weight) +
                                   (score_nSales['measure']*(1-corr_weight)))

    score_nCustomers = corr_nCustomers.merge(magnitude_nCustomers, how='inner', on=['Store1', 'Stor
e2'])
    score_nCustomers['scoreNCust'] = ((score_nCustomers['corr_measure']*corr_weight) +
                                      (score_nCustomers['measure']*(1-corr_weight)))

    score_Control = score_nSales.loc[:, ['Store1', 'Store2', 'scoreNSales']].merge(
        score_nCustomers.loc[:, ['Store1', 'Store2', 'scoreNCust']], how='inner', on=['Store1', 'St
ore2'])

    score_Control['finalControlScore'] = ((score_Control['scoreNSales']*0.5) +
                                          (score_Control['scoreNCust']*0.5))
    score_Control.sort_values('finalControlScore', ascending=False, inplace=True, ignore_index=True
)

    return score_Control
```

Getting the combined scores for trial store

In [8]:

```
trial_store_1 = 77
score_Control_1 = get_score_Control(trial_store_1)
score_Control_1
```

Out[8]:

	Store1	Store2	scoreNSales	scoreNCust	finalControlScore
0	77	77	1.000000	1.000000	1.000000
1	77	233	0.945125	0.991745	0.968435
2	77	41	0.875332	0.910434	0.892883
3	77	17	0.865450	0.856484	0.860967
4	77	254	0.752263	0.928571	0.840417
...	...	...	...	...	...
255	77	19	-0.031123	-0.035820	-0.033472
256	77	138	-0.029810	-0.055213	-0.042512
257	77	247	-0.035049	-0.078374	-0.056711
258	77	102	-0.010742	-0.107857	-0.059299

	Store1	Store2	scoreNSales	scoreNCust	finalControlScore
259	77	72	0.484764	0.415307	0.165294

260 rows × 5 columns

Selecting control store based on second highest score i.e. not the trial store itself

In [9]:

```
control_store_1 = score_Control_1.iloc[1,1]
control_store_1
```

Out[9]:

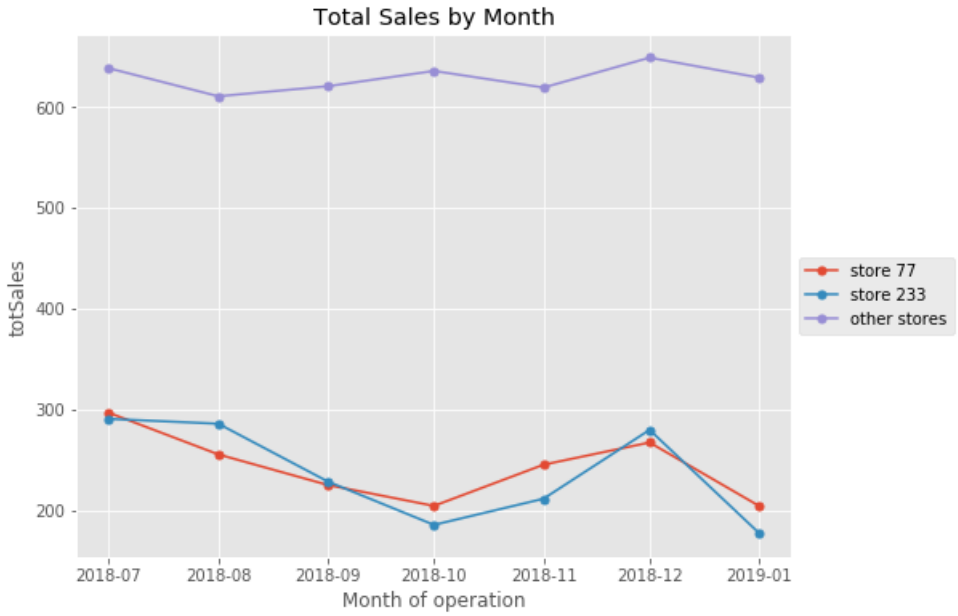
233

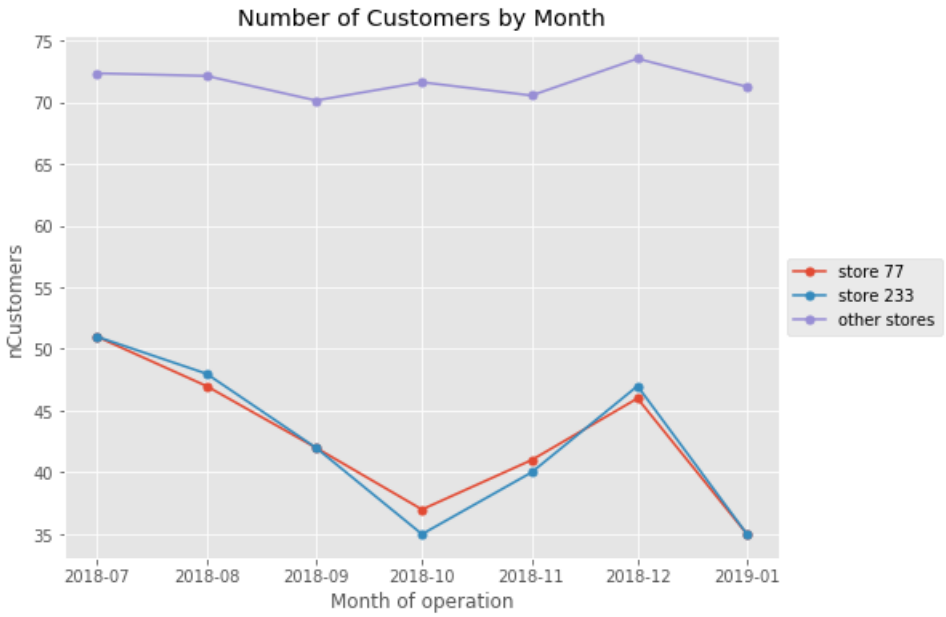
Store 233 is selected as the control store for trial store 77

Performing visual checks

In [10]:

```
import datetime as dt

def visual_check(trial_store, control_store, metricCol, title):
    fig, ax = plt.subplots(figsize=(8,6))
    other_stores = preTrialMeasures.loc[~preTrialMeasures['STORE_NBR'].isin([trial_store, control_s
tore]), :]
    other_stores = other_stores.groupby('YEARMONTH')[metricCol].mean()

    for store in [trial_store, control_store]:
        months = preTrialMeasures.loc[preTrialMeasures['STORE_NBR'] == store, 'YEARMONTH']
        months = months.apply(lambda e:dt.datetime.strptime(str(e), '%Y%m'))
        sales = preTrialMeasures.loc[preTrialMeasures['STORE_NBR'] == store, metricCol]
        ax.plot(months, sales, '-o', label='store '+str(store), markersize=5)

    ax.plot(months, other_stores, '-o', label='other stores', markersize=5)

    ax.set_xlabel('Month of operation')
    ax.set_ylabel(metricCol)
    ax.set_title(title)
    ax.legend(loc='center left', bbox_to_anchor=(1, 0.5))
    plt.show()

visual_check(trial_store_1, control_store_1, 'totSales', 'Total Sales by Month')
visual_check(trial_store_1, control_store_1, 'nCustomers', 'Number of Customers by Month')
```





Scaling control store sales

In [11]:

```
def get_scaled_values(trial_store, control_store, metricCol):
    t_sum = preTrialMeasures.loc[preTrialMeasures['STORE_NBR'] == trial_store, metricCol].sum()
    c_sum = preTrialMeasures.loc[preTrialMeasures['STORE_NBR'] == control_store, metricCol].sum()

    scalingFactor = t_sum / c_sum

    scaledMetricCol = measureOverTime.loc[measureOverTime['STORE_NBR'] == control_store,
                                          [metricCol, 'YEARMONTH']]

    scaledMetricCol[metricCol] = scaledMetricCol[metricCol] * scalingFactor
    scaledMetricCol.reset_index(inplace=True, drop=True)
    return scaledMetricCol

scaledControlSales = get_scaled_values(trial_store_1, control_store_1, 'totSales')
scaledControlSales
```

Out[11]:

	totSales	YEARMONTH
0	297.565550	201807
1	292.652187	201808
2	233.998916	201809
3	190.085733	201810
4	216.597421	201811
5	286.408121	201812
6	181.692071	201901
7	249.762622	201902
8	203.802205	201903
9	162.345704	201904
10	352.533799	201905
11	226.219424	201906

Calculating percentage difference

In [12]:

```
def cal_percentageDiff(trial_store_metrics, scaled_control_store_metrics, metricCol):
    percentageDiff = pd.DataFrame(trial_store_metrics['YEARMONTH'])
    percentageDiff['percentageDiff'] = (abs(scaled_control_store_metrics[metricCol] -
                                            trial_store_metrics[metricCol]) /
                                        (scaled_control_store_metrics[metricCol]))
    return percentageDiff

trial_store1_sales = measureOverTime.loc[measureOverTime['STORE_NBR'] == trial_store_1, ['totSales'
, 'YEARMONTH']]
trial_store1_sales.reset_index(inplace=True, drop=True)

percentageDiff = cal_percentageDiff(trial_store1_sales, scaledControlSales, 'totSales')
percentageDiff
```

Out[12]:

	YEARMONTH	percentageDiff
0	201807	0.002573
1	201808	0.126950
2	201809	0.037602
3	201810	0.075830
4	201811	0.132516
5	201812	0.066716
6	201901	0.124980
7	201902	0.059107
8	201903	0.366521
9	201904	0.623080
10	201905	0.151003
11	201906	0.170103

Calculating t-values for trial months

In [13]:

```
from math import sqrt
from scipy import stats

def get_tvalues(x, std, n, alpha):
    tvalue = ((x - 0) / std)
    degreesOfFreedom = n-1
    critical_t = stats.t.ppf(1-(alpha), degreesOfFreedom) #one-tail
    return round(tvalue, 3), round(critical_t, 3)

stdDev = percentageDiff.loc[percentageDiff['YEARMONTH'] < 201902, 'percentageDiff'].std()
n = len(percentageDiff.loc[percentageDiff['YEARMONTH'] < 201902, 'percentageDiff'])
alpha = 0.05

trial_months_tvalues = {}
trial_months = [201902,201903,201904]
for trial_month in trial_months:
    x = percentageDiff.loc[percentageDiff['YEARMONTH'] == trial_month, 'percentageDiff']
    x = x.values[0]
    t, t0 = get_tvalues(x, stdDev, n, alpha)
    trial_months_tvalues[trial_month] = (t, t0)

trial_months_tvalues
```

Out[13]:

```
{201902: (1.184, 1.943), 201903: (7.339, 1.943), 201904: (12.476, 1.943)}
```

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.

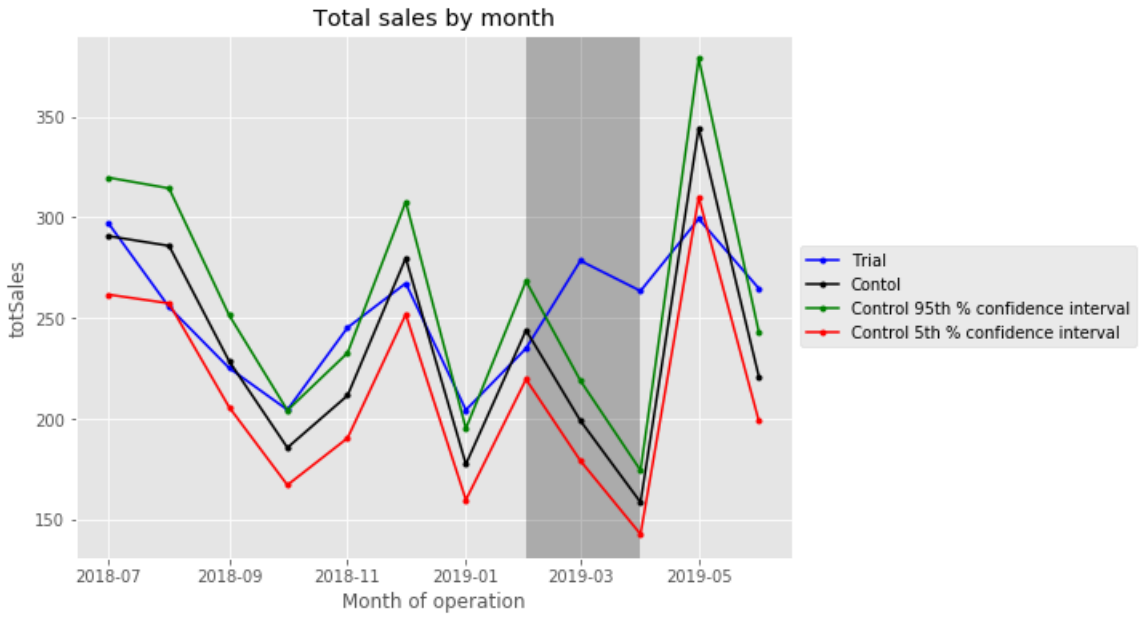
Note - there are 7 months in the pre-trial period i.e. 2018-07 to 2019-01 and not 8 as mentioned in the solution template.

Hence, degrees of freedom should be 7-1 = 6

Assessing trial period for total sales

In [14]:

```
from matplotlib.patches import Rectangle

def visualize_trial_assessment(trial_store, control_store, metricCol, stdDev, title):
    trial_metrics = measureOverTime.loc[measureOverTime['STORE_NBR'] == trial_store,
                                        ['YEARMONTH', metricCol]]
    control_metrics = measureOverTime.loc[measureOverTime['STORE_NBR'] == control_store,
                                          ['YEARMONTH', metricCol]]
    past_Controls95 = control_metrics[metricCol] * (1 + stdDev * 2)
    past_Controls5 = control_metrics[metricCol] * (1 - stdDev * 2)

    months = trial_metrics['YEARMONTH'].apply(lambda e:dt.datetime.strptime(str(e), '%Y%m'))

    fig, ax = plt.subplots(figsize=(8,6))
    ax.plot(months, trial_metrics[metricCol], '-o', color='b', label='Trial', markersize=3)
    ax.plot(months, control_metrics[metricCol], '-o', color='k', label='Contol', markersize=3)
    ax.plot(months, past_Controls95, '-o', color='g', label='Control 95th % confidence interval', m
arkersize=3)
    ax.plot(months, past_Controls5, '-o', color='r', label='Control 5th % confidence interval', mar
kersize=3)
    plt.legend(loc='center left', bbox_to_anchor=(1, 0.5))

    start = months.iloc[7]
    end = months.iloc[9]
    width = end - start

    rect = Rectangle((start,0), width, plt.ylim()[1], facecolor='k', alpha=0.25)
    ax.add_patch(rect)
    ax.set_xlabel('Month of operation')
    ax.set_ylabel(metricCol)
    ax.set_title(title)
    plt.show()

visualize_trial_assessment(trial_store_1, control_store_1, 'totSales', stdDev, 'Total sales by mont
h')
```



For number of Customers

In [15]:

```
scaledControlCustomers = get_scaled_values(trial_store_1, control_store_1, 'nCustomers')
```

```
scaledControlCustomers
```

Out[15]:

	nCustomers	YEARMONTH
0	51.171141	201807
1	48.161074	201808
2	42.140940	201809
3	35.117450	201810
4	40.134228	201811
5	47.157718	201812
6	35.117450	201901
7	45.151007	201902
8	40.134228	201903
9	30.100671	201904
10	57.191275	201905
11	41.137584	201906

In [16]:

```
trial_store1_custs = measureOverTime.loc[measureOverTime['STORE_NBR'] == trial_store_1, ['nCustomers', 'YEARMONTH']]
trial_store1_custs.reset_index(inplace=True, drop=True)

percentageDiff = cal_percentageDiff(trial_store1_custs, scaledControlCustomers, 'nCustomers')
percentageDiff
```

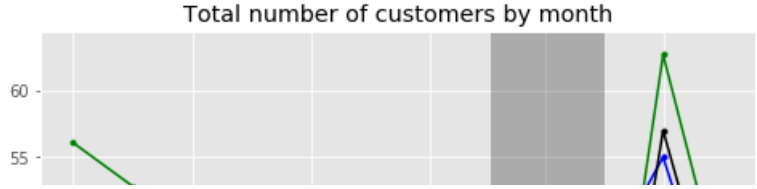
Out[16]:

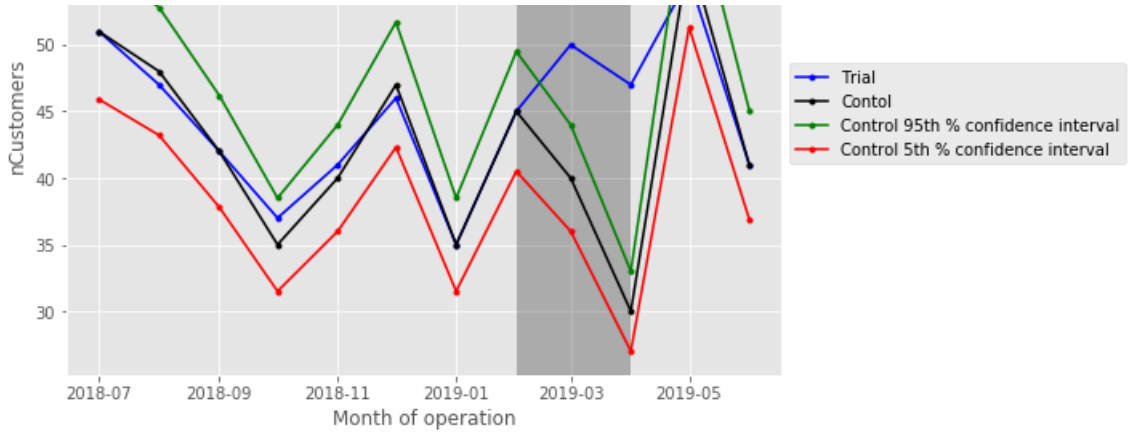
	YEARMONTH	percentageDiff
0	201807	0.003344
1	201808	0.024108
2	201809	0.003344
3	201810	0.053607
4	201811	0.021572
5	201812	0.024550
6	201901	0.003344
7	201902	0.003344
8	201903	0.245819
9	201904	0.561427
10	201905	0.038315
11	201906	0.003344

Assessing trial period for number of customers

In [17]:

```
visualize_trial_assessment(trial_store_1, control_store_1, 'nCustomers', stdDev, 'Total number of customers by month')
```





For trial store 86

In [18]:

```
trial_store_2 = 86
score_Control_2 = get_score_Control(trial_store_2)
score_Control_2
```

Out[18]:

	Store1	Store2	scoreNSales	scoreNCust	finalControlScore
0	86	86	1.000000	1.000000	1.000000
1	86	155	0.921777	0.964824	0.943300
2	86	109	0.877439	0.870177	0.873808
3	86	114	0.830855	0.898569	0.864712
4	86	138	0.845335	0.842443	0.843889
...	...	...	...	...	...
255	86	108	-0.224603	-0.146903	-0.185753
256	86	52	-0.243839	-0.231754	-0.237796
257	86	120	-0.317708	-0.192601	-0.255155
258	86	42	-0.322704	-0.267661	-0.295183
259	86	146	-0.337846	-0.268437	-0.303141

260 rows × 5 columns

In [19]:

```
control_store_2 = score_Control_2.iloc[1,1]
control_store_2
```

Out[19]:

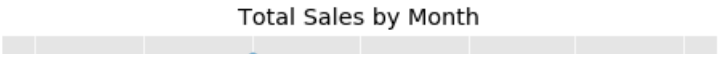
```
155
```

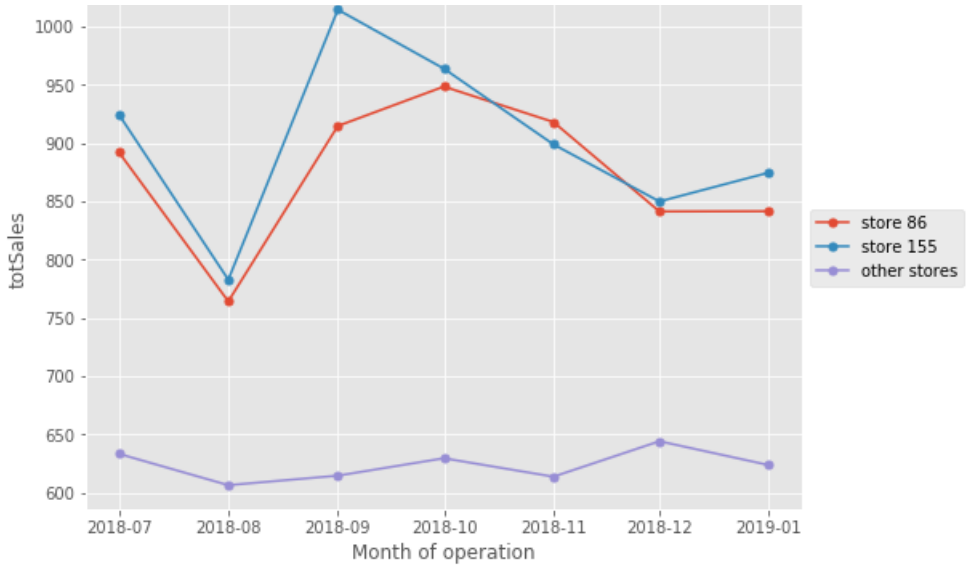
Store 155 is selected as the control store for trial store 86

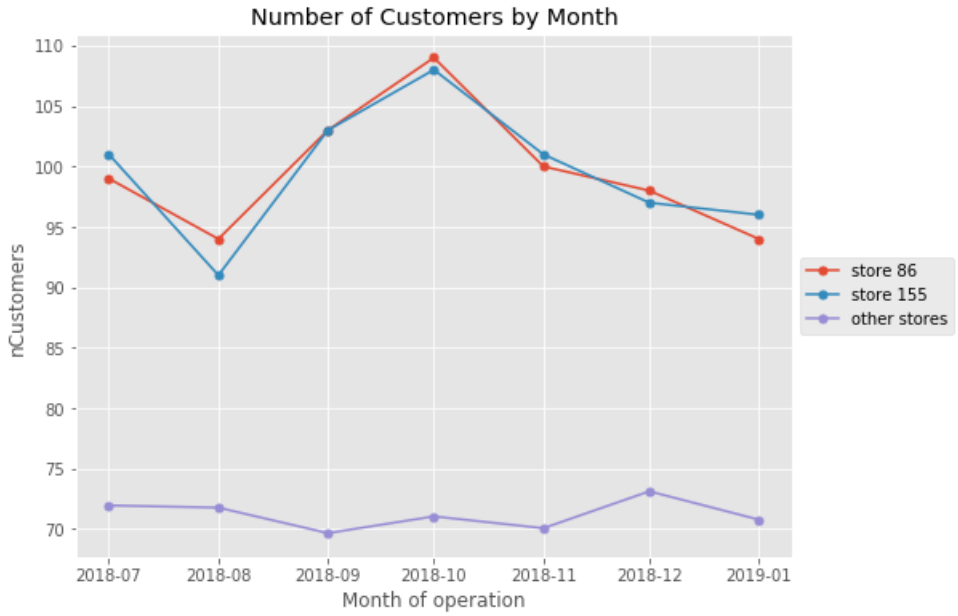
Performing Visual Checks

In [20]:

```
visual_check(trial_store_2, control_store_2, 'totSales', 'Total Sales by Month')
visual_check(trial_store_2, control_store_2, 'nCustomers', 'Number of Customers by Month')
```







Scaling control store sales

In [21]:

```
scaledControlSales = get_scaled_values(trial_store_2, control_store_2, 'totSales')
scaledControlSales
```

Out[21]:

	totSales	YEARMONTH
0	896.922236	201807
1	759.269991	201808
2	984.034086	201809
3	934.948790	201810
4	871.894555	201811
5	824.361363	201812
6	848.418979	201901
7	864.522060	201902
8	780.320405	201903
9	819.317024	201904
10	895.224622	201905

	totSales	YEARMONTH
11	831.333333	201906

Calculating percentage difference

In [22]:

```
trial_store2_sales = measureOverTime.loc[measureOverTime['STORE_NBR'] == trial_store_2, ['totSales'
, 'YEARMONTH']]
trial_store2_sales.reset_index(inplace=True, drop=True)

percentageDiff = cal_percentageDiff(trial_store2_sales, scaledControlSales, 'totSales')
percentageDiff
```

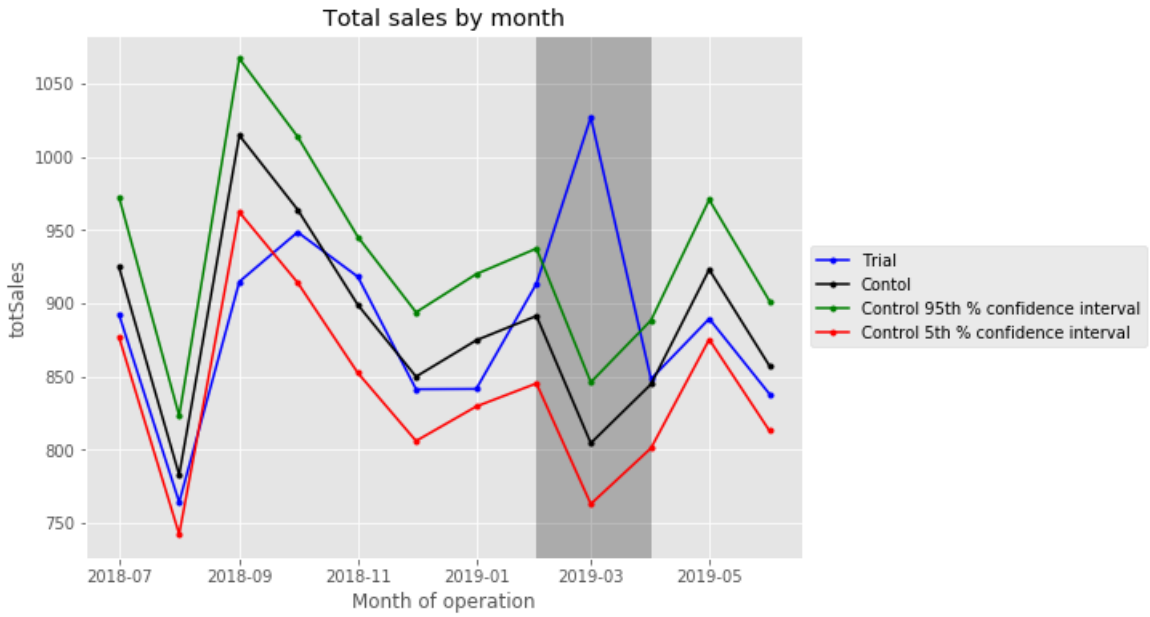
Out[22]:

	YEARMONTH	percentageDiff
0	201807	0.005265
1	201808	0.006296
2	201809	0.070561
3	201810	0.014387
4	201811	0.052880
5	201812	0.020426
6	201901	0.008273
7	201902	0.056306
8	201903	0.315870
9	201904	0.035253
10	201905	0.006618
11	201906	0.007769

Assessing trial period for total sales

In [23]:

```
stdDev = percentageDiff.loc[percentageDiff['YEARMONTH'] < 201902, 'percentageDiff'].std()
visualize_trial_assessment(trial_store_2, control_store_2, 'totSales', stdDev, 'Total sales by mont
h')
```



For number of customers

In [24]:

```
scaledControlCustomers = get_scaled_values(trial_store_2, control_store_2, 'nCustomers')
scaledControlCustomers
```

Out[24]:

	nCustomers	YEARMONTH
0	101.0	201807
1	91.0	201808
2	103.0	201809
3	108.0	201810
4	101.0	201811
5	97.0	201812
6	96.0	201901
7	95.0	201902
8	94.0	201903
9	99.0	201904
10	106.0	201905
11	95.0	201906

In [25]:

```
trial_store2_custs = measureOverTime.loc[measureOverTime['STORE_NBR'] == trial_store_2, ['nCustomer
s', 'YEARMONTH']]
trial_store2_custs.reset_index(inplace=True, drop=True)

percentageDiff = cal_percentageDiff(trial_store2_custs, scaledControlCustomers, 'nCustomers')
percentageDiff
```

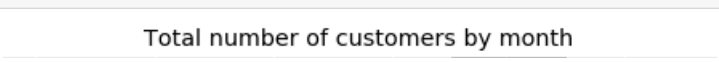
Out[25]:

	YEARMONTH	percentageDiff
0	201807	0.019802
1	201808	0.032967
2	201809	0.000000
3	201810	0.009259
4	201811	0.009901
5	201812	0.010309
6	201901	0.020833
7	201902	0.126316
8	201903	0.223404
9	201904	0.060606
10	201905	0.018868
11	201906	0.031579

Assessing trial period for number of customers

In [26]:

```
stdDev = percentageDiff.loc[percentageDiff['YEARMONTH'] < 201902, 'percentageDiff'].std()
visualize_trial_assessment(trial_store_2, control_store_2, 'nCustomers', stdDev, 'Total number of
customers by month')
```



For trial store 88

In [27]:

```
trial_store_3 = 88
score_Control_3 = get_score_Control(trial_store_3)
score_Control_3
```

Out[27]:

	Store1	Store2	scoreNSales	scoreNCust	finalControlScore
0	88	88	1.000000	1.000000	1.000000
1	88	178	0.722226	0.883908	0.803067
2	88	237	0.633538	0.967572	0.800555
3	88	69	0.587019	0.845327	0.716173
4	88	113	0.598055	0.827772	0.712914
...	...	...	...	...	...
255	88	90	-0.218280	-0.078002	-0.148141
256	88	258	0.078155	-0.385239	-0.153542
257	88	42	-0.226324	-0.106957	-0.166641
258	88	141	-0.223195	-0.110909	-0.167052
259	88	239	-0.174380	-0.165331	-0.169855

260 rows × 5 columns

In [28]:

```
control_store_3 = score_Control_3.iloc[2,1]
control_store_3
```

Out[28]:

```
237
```

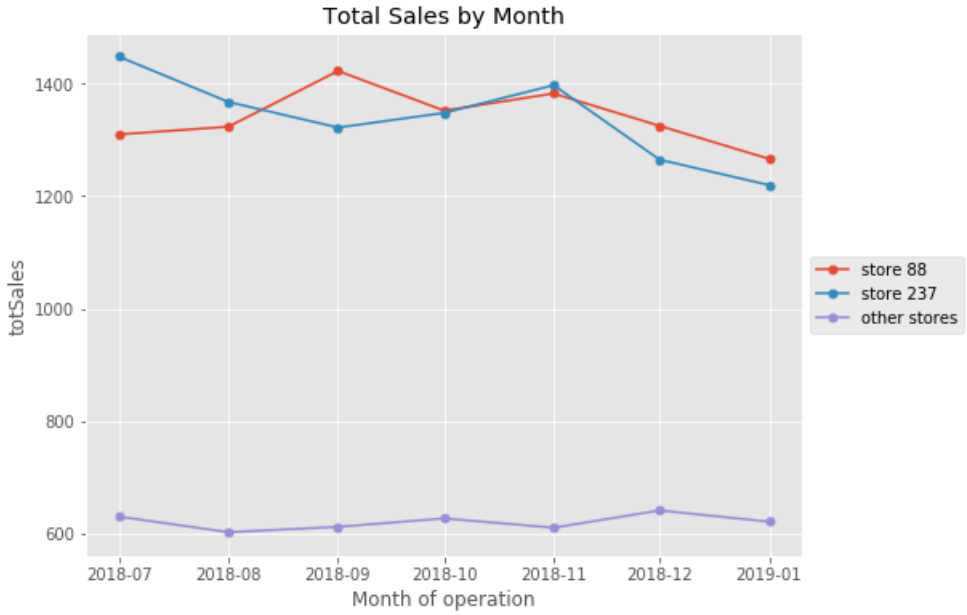
Store 237 is selected as the control store for trial store 88

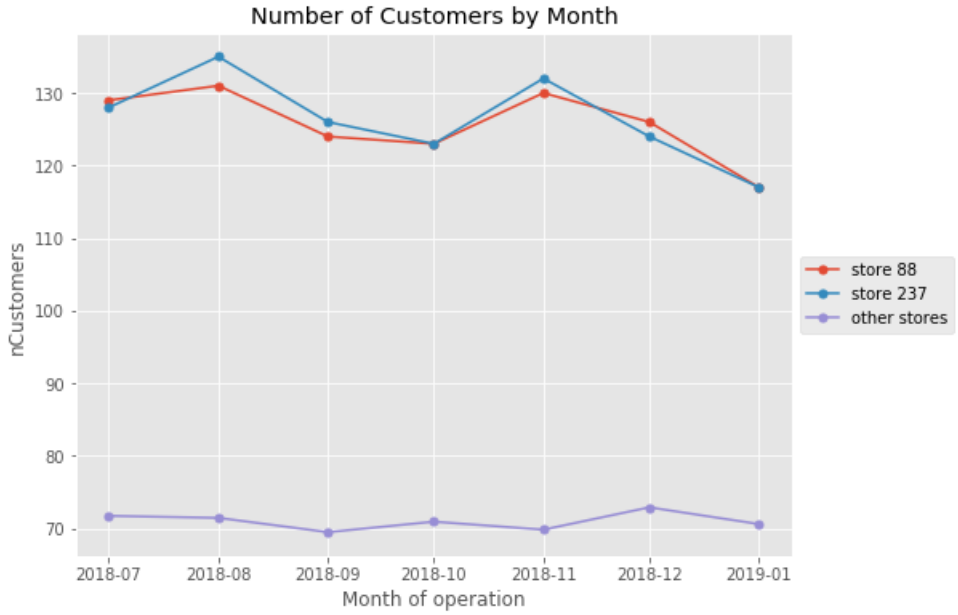
Note : store 178 has the second highest ranking according to scores but visual checks suggest store 237 is better which has the third highest ranking

Performing visual checks

In [29]:

```
visual_check(trial_store_3, control_store_3, 'totSales', 'Total Sales by Month')
visual_check(trial_store_3, control_store_3, 'nCustomers', 'Number of Customers by Month')
```





Scaling control sales

In [30]:

```
scaledControlSales = get_scaled_values(trial_store_3, control_store_3, 'totSales')
scaledControlSales
```

Out[30]:

	totSales	YEARMONTH
0	1450.657086	201807
1	1369.931485	201808
2	1324.260425	201809
3	1350.401097	201810
4	1399.777923	201811

	totSales	YEARMONTH
5	1266.971288	201812
6	1221.600696	201901
7	1406.989143	201902
8	1210.082775	201903
9	1206.477165	201904
10	1201.168906	201905
11	1155.397690	201906

In [31]:

```
trial_store3_sales = measureOverTime.loc[measureOverTime['STORE_NBR'] == trial_store_3, ['totSales'
, 'YEARMONTH']]
trial_store3_sales.reset_index(inplace=True, drop=True)

percentageDiff = cal_percentageDiff(trial_store3_sales, scaledControlSales, 'totSales')
percentageDiff
```

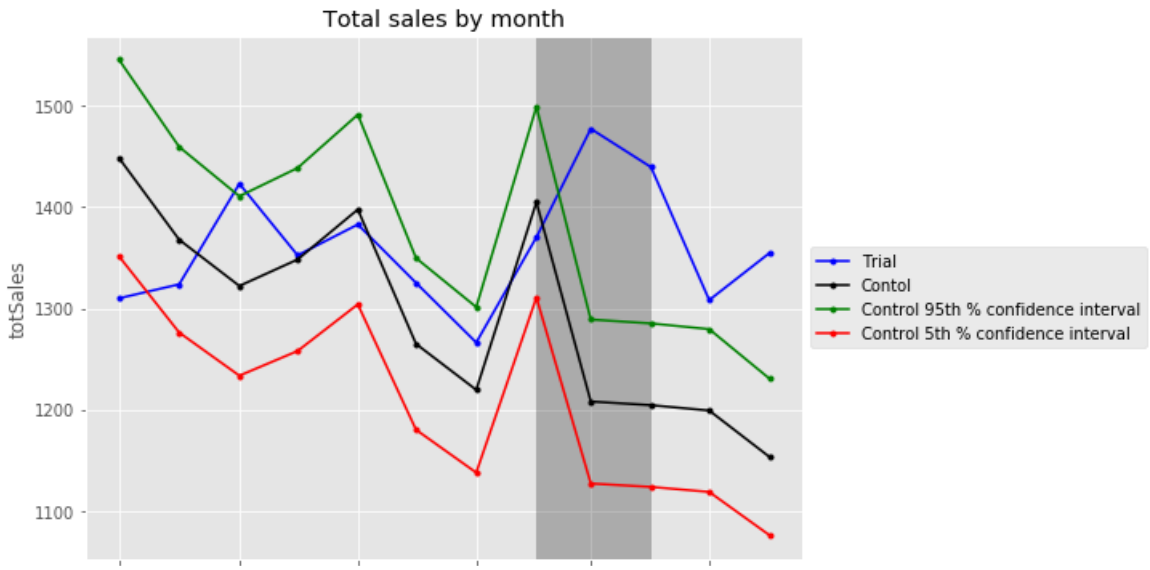
Out[31]:

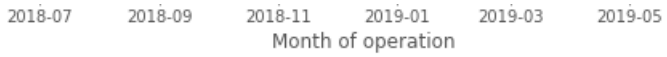
	YEARMONTH	percentageDiff
0	201807	0.096961
1	201808	0.033674
2	201809	0.074562
3	201810	0.001480
4	201811	0.012129
5	201812	0.045959
6	201901	0.036673
7	201902	0.026147
8	201903	0.220743
9	201904	0.193060
10	201905	0.089147
11	201906	0.172410

Assessing trial period for total sales

In [32]:

```
stdDev = percentageDiff.loc[percentageDiff['YEARMONTH'] < 201902, 'percentageDiff'].std()
visualize_trial_assessment(trial_store_3, control_store_3, 'totSales', stdDev, 'Total sales by mont
h')
```





For number of customers

In [33]:

```
scaledControlCustomers = get_scaled_values(trial_store_3, control_store_3, 'nCustomers')
scaledControlCustomers
```

Out[33]:

	nCustomers	YEARMONTH
0	127.276836	201807
1	134.237288	201808
2	125.288136	201809
3	122.305085	201810
4	131.254237	201811
5	123.299435	201812
6	116.338983	201901
7	125.288136	201902
8	118.327684	201903
9	119.322034	201904
10	128.271186	201905
11	118.327684	201906

In [34]:

```
trial_store3_custs = measureOverTime.loc[measureOverTime['STORE_NBR'] == trial_store_3, ['nCustomers', 'YEARMONTH']]
trial_store3_custs.reset_index(inplace=True, drop=True)

percentageDiff = cal_percentageDiff(trial_store3_custs, scaledControlCustomers, 'nCustomers')
percentageDiff
```

Out[34]:

	YEARMONTH	percentageDiff
0	201807	0.013539
1	201808	0.024116
2	201809	0.010281
3	201810	0.005682
4	201811	0.009556
5	201812	0.021902
6	201901	0.005682
7	201902	0.010281
8	201903	0.132448
9	201904	0.072727
10	201905	0.002114
11	201906	0.022584

Assessing trial period for number of customers

In [35]:

```
stdDev = percentageDiff.loc[percentageDiff['YEARMONTH'] < 201902, 'percentageDiff'].std()
```

```
visualize_trial_assessment(trial_store_3, control_store_3, 'nCustomers', stdDev, 'Total number of customers by month')
```