```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np


Data = pd.read_csv('/content/QVI_data.csv')


Data.head(2)
```

	LYLTY_CARD_NBR	DATE	STORE_NBR	TXN_ID	PROD_NBR	PROD_NAME	PROD_QTY	TOT_SALES
0	1000	2018-10-17	1	1	5	Natural Chip Compny SeaSalt175g	2	6.0
1	1002	2018-	1	2	58	Red Rock Deli	1	2.7

```
Data['DATE'] = pd.to_datetime(Data['DATE'])
Data['YEARMONTH'] = Data['DATE'].dt.strftime('%Y%m')
Data["MONTH_ID"] = Data["DATE"].dt.strftime("%Y%m").astype("int")


Data.head()
```

	LYLTY_CARD_NBR	DATE	STORE_NBR	TXN_ID	PROD_NBR	PROD_NAME	PROD_QTY	TOT_SALES
0	1000	2018-10-17	1	1	5	Natural Chip Compny SeaSalt175g	2	6.0
1	1002	2018-09-16	1	2	58	Red Rock Deli Chikn&Garlic Aioli 150g	1	2.7
2	1003	2019-03-07	1	3	52	Grain Waves Sour Cream&Chives 210G	1	3.6
3	1003	2019-03-08	1	4	106	Natural ChipCo Hony Soy Chckn175g	1	3.0
4	1004	2018-11-02	1	5	96	WW Original Stacked Chips 160g	1	1.9

We would want to match trial stores to control stores that are similar to the trial store prior to the trial period of Feb 2019 in terms of :

- Monthly overall sales revenue
- Monthly number of customers
- Monthly number of transactions per customer

```
# Monthly total sales
M_TOT_SALES = Data.groupby(["STORE_NBR","MONTH_ID"])["TOT_SALES"].sum()

# Monthly customer counts
M_CUS_COUNTS = Data.groupby(["STORE_NBR","MONTH_ID"])["LYLTY_CARD_NBR"].nunique()

# Monthly transactions per customer
M_TXN_CUS = Data.groupby(["STORE_NBR","MONTH_ID"])["TXN_ID"].nunique()/M_CUS_COUNTS

# Monthly chips per customer
M_CHIP_CUS = Data.groupby(["STORE_NBR","MONTH_ID"])["PROD_QTY"].sum()/M_CUS_COUNTS

# Monthly average price per unit
M_AVG_PRICE_CHIP = M_TOT_SALES/Data.groupby(["STORE_NBR","MONTH_ID"])["PROD_QTY"].sum()

# Combining metrics together
measure_over_time = pd.concat([M_TOT_SALES, M_CUS_COUNTS, M_TXN_CUS, M_CHIP_CUS, M_AVG_PRICE_CHIP],axis=1)
measure_over_time.columns = ["totSales", "nCustomers", "nTxnPerCust", "nChipsPerTxn", "avgPricePerUnit"]
measure_over_time = measure_over_time.reset_index()
```

```
measure_over_time.head()
```

	STORE_NBR	MONTH_ID	totSales	nCustomers	nTxnPerCust	nChipsPerTxn	avgPricePerUnit
0	1	201807	206.9	49	1.061224	1.265306	3.337097
1	1	201808	176.1	42	1.023810	1.285714	3.261111
2	1	201809	278.8	59	1.050847	1.271186	3.717333
3	1	201810	188.1	44	1.022727	1.318182	3.243103
4	1	201811	192.6	46	1.021739	1.239130	3.378947

Next steps: Generate code with `measure_over_time` View recommended plots

```
# Stores with full observation periods(12 month)
obs_counts = measure_over_time["STORE_NBR"].value_counts()
full_idx = obs_counts[obs_counts == 12].index
storesWithFullObs = measure_over_time[measure_over_time["STORE_NBR"].isin(full_idx)]

# Filter to the pre-trial period (201807 - 201901)
preTrialMeasures = storesWithFullObs[storesWithFullObs["MONTH_ID"] < 201902]
preTrialMeasures.head()
```

	STORE_NBR	MONTH_ID	totSales	nCustomers	nTxnPerCust	nChipsPerTxn	avgPricePerUnit
0	1	201807	206.9	49	1.061224	1.265306	3.337097
1	1	201808	176.1	42	1.023810	1.285714	3.261111
2	1	201809	278.8	59	1.050847	1.271186	3.717333
3	1	201810	188.1	44	1.022727	1.318182	3.243103
4	1	201811	192.6	46	1.021739	1.239130	3.378947

Next steps: Generate code with `preTrialMeasures` View recommended plots

```
def calculateCorrelation(inputTable, metricCol, storeComparison):

    control_all = inputTable.loc[~inputTable["STORE_NBR"].isin([77,86,88])]
    trial = inputTable.loc[inputTable["STORE_NBR"] == storeComparison][metricCol].reset_index()
    calcCorrTable = pd.DataFrame(columns = ["Control_Store", "Trial_Store", "Corr"])

    for i in control_all["STORE_NBR"].unique():
        control = control_all[control_all["STORE_NBR"]==i][metricCol].reset_index()
        correlation = control.corrwith(trial,axis=0)[1]
        calcCorrTable_i = pd.DataFrame({"Control_Store":i,"Trial_Store":storeComparison,"Corr":[correlation]})
        calcCorrTable = pd.concat([calcCorrTable, calcCorrTable_i])

    return calcCorrTable


def calculateMagnitudeDistance(inputTable, metricCol, storeComparison):


    control_all = inputTable.loc[~inputTable["STORE_NBR"].isin([77,86,88])]
    trial = inputTable.loc[inputTable["STORE_NBR"] == storeComparison].reset_index()[metricCol]
    calcDistTable = pd.DataFrame(columns=["Control_Store", "Trial_Store", "Magnitude"])

    for i in control_all["STORE_NBR"].unique():
        control = control_all[control_all["STORE_NBR"]==i].reset_index()[metricCol]
        diff = abs(trial - control)
        # Standardise the magnitude distance so that the measure ranges from 0 to 1
        s_diff = np.mean(1-((diff-min(diff))/(max(diff)-min(diff))))
        calcDistTable_i = pd.DataFrame({"Control_Store":i,"Trial_Store":[storeComparison],"Magnitude": s_diff})
        calcDistTable = pd.concat([calcDistTable, calcDistTable_i])
    return calcDistTable
```

```
# calculate correlations against store 77 using total sales and number of customers
# total sales - corr
corr_nSales_77 = calculateCorrelation(preTrialMeasures,"totSales",77)

# total sales - magnitude distance
magnitude_nSales_77 = calculateMagnitudeDistance(preTrialMeasures,"totSales",77)

# number of customers - corr
corr_nCustomers_77 = calculateCorrelation(preTrialMeasures,"nCustomers",77)

# number of customers - magnitude distance
magnitude_nCustomers_77 = calculateMagnitudeDistance(preTrialMeasures,"nCustomers",77)


# Create a combined score composed of correlation and magnitude
# Merging the correlations table with the magnitude table - Total sales
nSales_77_merge = pd.concat([corr_nSales_77,magnitude_nSales_77["Magnitude"]],axis=1)

# Calculate a combined score - Total sales
corr_weight_a = 0.5
nSales_77_merge["score_nSales"] = corr_weight_a * nSales_77_merge["Corr"] + (1-corr_weight_a) * nSales_77_merge["Magnitude"]
nSales_77_merge.head()
```

	Control_Store	Trial_Store	Corr	Magnitude	score_nSales
0	1	77	0.075218	0.408163	0.241691
0	2	77	-0.263079	0.590119	0.163520
0	3	77	0.806644	0.522914	0.664779
0	4	77	-0.263300	0.644934	0.190817
0	5	77	-0.110652	0.516320	0.202834

```
# Merging the correlations table with the magnitude table - number of Customers
nCustomers_77_merge = pd.concat([corr_nCustomers_77,magnitude_nCustomers_77["Magnitude"]],axis=1)

# Calculate a combined score - number of Customers
corr_weight_b = 0.5
nCustomers_77_merge["score_nCustomers"] = corr_weight_b * nCustomers_77_merge["Corr"] + (1-corr_weight_b) * nCustomers_77_merge["Magnitude"]
nCustomers_77_merge.head()
```

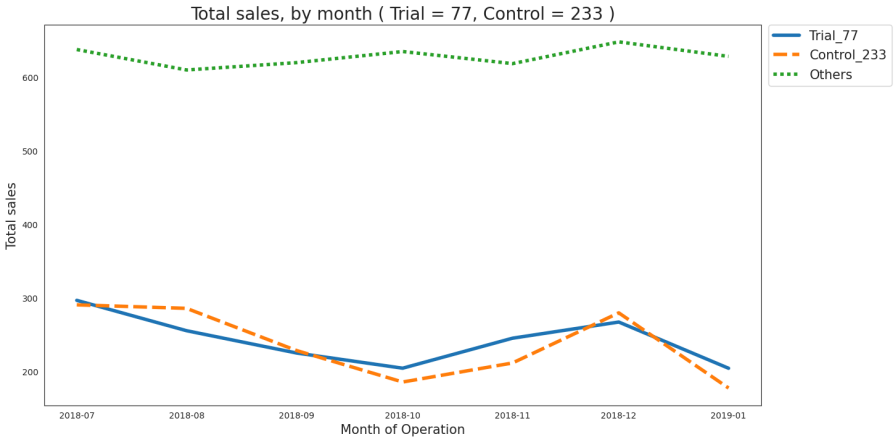
	Control_Store	Trial_Store	Corr	Magnitude	score_nCustomers
0	1	77	0.322168	0.663866	0.493017
0	2	77	-0.572051	0.471429	-0.050311
0	3	77	0.834207	0.489796	0.662002
0	4	77	-0.295639	0.498258	0.101310
0	5	77	0.370659	0.512605	0.441632

```
# Merging the score tables
finalControlScore_77 = pd.concat([nSales_77_merge[["Control_Store", "Trial_Store", "score_nSales"]],nCustomers_77_merge["score_nCustomers"]]

# Calculate a final score
corr_weight_c = 0.5
finalControlScore_77["finalControlScore"] = corr_weight_c * finalControlScore_77["score_nSales"] + (1-corr_weight_c) * finalControlScore_77[
finalControlScore_77.head()


finalControlScore_77.sort_values(by="finalControlScore",ascending=False).head()
```

	Control_Store	Trial_Store	score_nSales	score_nCustomers	finalControlScore
0	233	77	0.697290	0.816607	0.756949
0	71	77	0.789497	0.663123	0.726310
0	84	77	0.656972	0.715000	0.685986
0	119	77	0.636046	0.729729	0.682887
0	115	77	0.708347	0.645155	0.676751

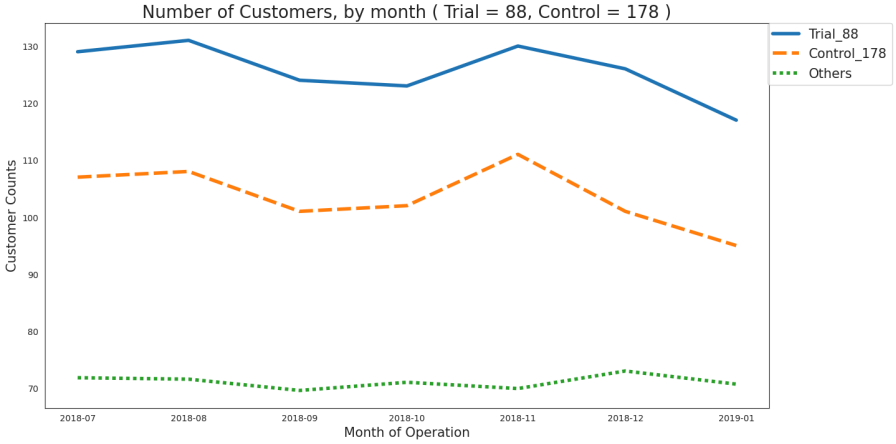
```
# Visual checks on trends based on the drivers - total sales
a = preTrialMeasures.set_index(["MONTH_ID","STORE_NBR"])["totSales"].unstack()
others_col = [i for i in a.columns if i not in [77, 233]]
a["others"]=a.loc[:,others_col].mean(axis=1)
paired_77_s = a.loc[:,([77,233,"others"])].reset_index()
paired_77_s["MONTH_ID"]= pd.to_datetime(paired_77_s["MONTH_ID"], format="%Y%m")
paired_77_s = paired_77_s.set_index(["MONTH_ID"])
paired_77_s.columns=["Trial_77","Control_233","Others"]

# Create a lineplot
sns.set_style('white')
plt.figure(figsize=(15,8))
plt.title("Total sales, by month ( Trial = 77, Control = 233 )",fontsize=20)
sns.lineplot(data=paired_77_s, linewidth=4)
plt.xlabel("Month of Operation",fontsize=15)
plt.ylabel("Total sales",fontsize=15)
plt.legend(fontsize=15, bbox_to_anchor=(1.01,1),borderaxespad = 0.)
```

```
<matplotlib.legend.Legend at 0x795bfc4a80a0>
```



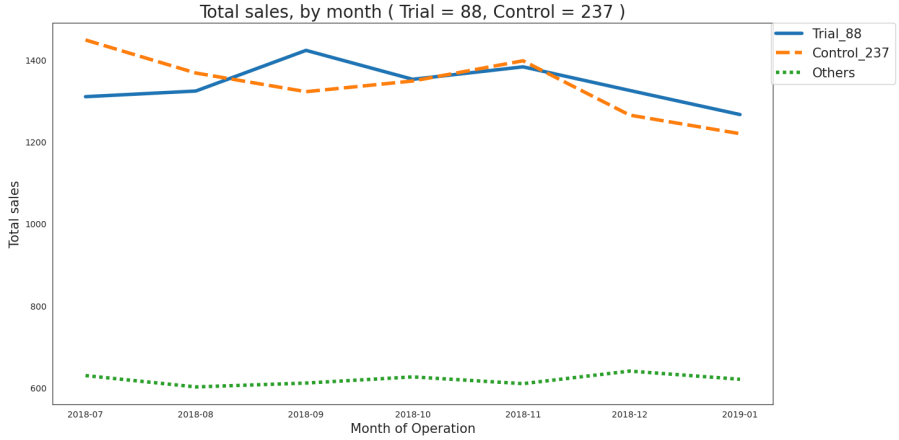

```
# Visual checks on trends based on the drivers - number of customers
b = preTrialMeasures.set_index(["MONTH_ID","STORE_NBR"])["nCustomers"].unstack()
others_col = [i for i in b.columns if i not in [88, 178]]
b["others"]=b.loc[:,others_col].mean(axis=1)
paired_88_c = b.loc[:,([88,178,"others"])].reset_index()
paired_88_c["MONTH_ID"]= pd.to_datetime(paired_88_c["MONTH_ID"], format="%Y%m")
paired_88_c = paired_88_c.set_index(["MONTH_ID"])
paired_88_c.columns=["Trial_88","Control_178","Others"]

# Create a lineplot
plt.figure(figsize=(15,8))
plt.title("Number of Customers, by month ( Trial = 88, Control = 178 )",fontsize=20)
sns.lineplot(data=paired_88_c, linewidth=4)
plt.xlabel("Month of Operation",fontsize=15)
plt.ylabel("Customer Counts",fontsize=15)
plt.legend(fontsize=15, bbox_to_anchor=(1.17,1),borderaxespad = 0.)
```

```
<matplotlib.legend.Legend at 0x795bfd5e9600>
```



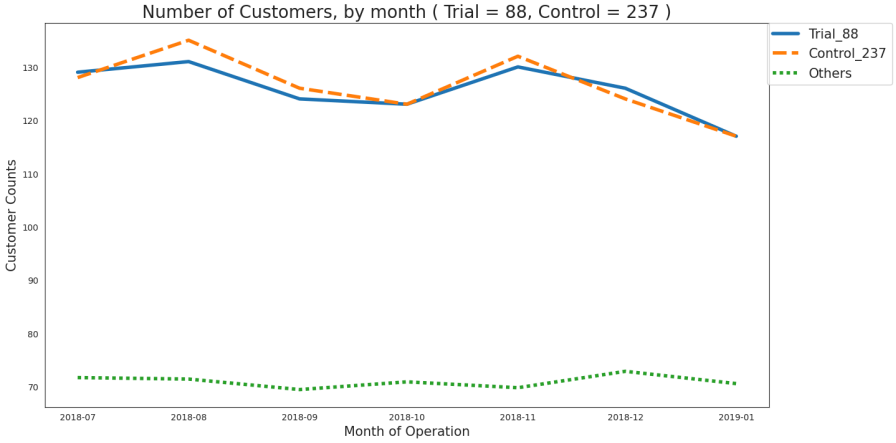

```
a = preTrialMeasures.set_index(["MONTH_ID","STORE_NBR"])["totSales"].unstack()
others_col = [i for i in a.columns if i not in [88, 237]]
a["others"]=a.loc[:,others_col].mean(axis=1)
paired_88_s = a.loc[:,([88,237,"others"])].reset_index()
paired_88_s["MONTH_ID"]= pd.to_datetime(paired_88_s["MONTH_ID"], format="%Y%m")
paired_88_s = paired_88_s.set_index(["MONTH_ID"])
paired_88_s.columns=["Trial_88","Control_237","Others"]

# Create a lineplot
sns.set_style('white')
plt.figure(figsize=(15,8))
plt.title("Total sales, by month ( Trial = 88, Control = 237 )",fontsize=20)
sns.lineplot(data=paired_88_s, linewidth=4)
plt.xlabel("Month of Operation",fontsize=15)
plt.ylabel("Total sales",fontsize=15)
plt.legend(fontsize=15, bbox_to_anchor=(1.17,1),borderaxespad = 0.)
```

```
<matplotlib.legend.Legend at 0x795bfd48d720>
```




```
b = preTrialMeasures.set_index(["MONTH_ID","STORE_NBR"])["nCustomers"].unstack()
others_col = [i for i in b.columns if i not in [88, 237]]
b["others"]=b.loc[:,others_col].mean(axis=1)
paired_88_c = b.loc[:,([88,237,"others"])].reset_index()
paired_88_c["MONTH_ID"]= pd.to_datetime(paired_88_c["MONTH_ID"], format="%Y%m")
paired_88_c = paired_88_c.set_index(["MONTH_ID"])
paired_88_c.columns=["Trial_88","Control_237","Others"]

# Create a lineplot
plt.figure(figsize=(15,8))
plt.title("Number of Customers, by month ( Trial = 88, Control = 237 )",fontsize=20)
sns.lineplot(data=paired_88_c, linewidth=4)
plt.xlabel("Month of Operation",fontsize=15)
plt.ylabel("Customer Counts",fontsize=15)
plt.legend(fontsize=15, bbox_to_anchor=(1.17,1),borderaxespad = 0.)
```

```
<matplotlib.legend.Legend at 0x795bfd535450>
```



2. Assessment of trial 1） Total sales

(1) Store 77

The trial period goes from the start of February 2019 to April 2019. We now want to see if there has been an uplift in overall chip sales. We'll start with scaling the control store's sales to a level similar to control for any differences between the two stores outside of the trial period.

```
# Scale pre-trial control sales to match pre-trial trial store sales
scalingControlSales_77 = (preTrialMeasures[preTrialMeasures["STORE_NBR"] == 77]["totSales"].sum()) / (preTrialMeasures[preTrialMeasures["STC
scalingControlSales_77
```

```
1.023617303289553
```

```
# Apply the scaling factor
scaledControlSales_77 = measure_over_time[measure_over_time["STORE_NBR"]== 233]
scaledControlSales_77["controlSales"] = scaledControlSales_77["totSales"] * scalingControlSales_77
scaledControlSales_77
```

```
<ipython-input-30-a9596ca1a227>:3: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_
  scaledControlSales_77["controlSales"] = scaledControlSales_77["totSales"] * scalingCor
```

	STORE_NBR	MONTH_ID	totSales	nCustomers	nTxnPerCust	nChipsPerTxn	avgPricePerU
2699	233	201807	290.7	51	1.058824	1.725490	3.303
2700	233	201808	285.9	48	1.041667	1.666667	3.573
2701	233	201809	228.6	42	1.071429	1.666667	3.265
2702	233	201810	185.7	35	1.028571	1.600000	3.316
2703	233	201811	211.6	40	1.025000	1.550000	3.412
2704	233	201812	279.8	47	1.063830	1.595745	3.730
2705	233	201901	177.5	35	1.000000	1.342857	3.776
2706	233	201902	244.0	45	1.044444	1.555556	3.485
2707	233	201903	199.1	40	1.025000	1.475000	3.374
2708	233	201904	158.6	30	1.066667	1.533333	3.447
2709	233	201905	344.4	57	1.087719	1.614035	3.743
2710	233	201906	221.0	41	1.000000	1.487805	3.622

Next steps: Generate code with `scaledControlSales_77` View recommended plots

```
trialSales_77 = measure_over_time[measure_over_time["STORE_NBR"]== 77].reset_index(drop=True)
scaledControlSales_77 = scaledControlSales_77.reset_index(drop=True)
percentageDiff_77_s = pd.concat([trialSales_77["MONTH_ID"],trialSales_77["totSales"],scaledControlSales_77["controlSales"]],axis=1)
percentageDiff_77_s.columns=["MONTH_ID","trialSales","controlSales"]
percentageDiff_77_s["percentageDiff"]= (abs(percentageDiff_77_s["trialSales"]-percentageDiff_77_s["controlSales"]))/percentageDiff_77_s["conti
percentageDiff_77_s
```

	MONTH_ID	trialSales	controlSales	percentageDiff
0	201807	296.8	297.565550	0.002573
1	201808	255.5	292.652187	0.126950
2	201809	225.2	233.998916	0.037602
3	201810	204.5	190.085733	0.075830
4	201811	245.3	216.597421	0.132516
5	201812	267.3	286.408121	0.066716
6	201901	204.4	181.692071	0.124980
7	201902	235.0	249.762622	0.059107
8	201903	278.5	203.802205	0.366521
9	201904	263.5	162.345704	0.623080
10	201905	299.3	352.533799	0.151003
11	201906	264.7	226.219424	0.170103

Next steps: Generate code with `percentageDiff_77_s` View recommended plots

```
dof = 7

# standard deviation of percentage difference in pre-trail period
stdDev_77_s = percentageDiff_77_s[percentageDiff_77_s["MONTH_ID"]<201902]["percentageDiff"].std()
stdDev_77_s
```

```
0.04994076264142537
```

```
# Calculate the t-values for the trial months.
percentageDiff_77_s["tValue"] = (percentageDiff_77_s["percentageDiff"]-0)/stdDev_77_s
percentageDiff_77_s
```

	MONTH_ID	trialSales	controlSales	percentageDiff	tValue
0	201807	296.8	297.565550	0.002573	0.051515
1	201808	255.5	292.652187	0.126950	2.542011
2	201809	225.2	233.998916	0.037602	0.752940
3	201810	204.5	190.085733	0.075830	1.518406
4	201811	245.3	216.597421	0.132516	2.653459
5	201812	267.3	286.408121	0.066716	1.335911
6	201901	204.4	181.692071	0.124980	2.502571
7	201902	235.0	249.762622	0.059107	1.183534
8	201903	278.5	203.802205	0.366521	7.339116
9	201904	263.5	162.345704	0.623080	12.476373
10	201905	299.3	352.533799	0.151003	3.023650
11	201906	264.7	226.219424	0.170103	3.406093

Next steps: Generate code with percentageDiff_77_s View recommended plots

```
# Critical value under 95% confidence & degree of freedom = 7
from scipy.stats import t
t.ppf(0.975,dof) # two-tail
```

```
2.3646242510102993
```

```
measureOverTimeSales_77 = measure_over_time
pastSales_77 = measureOverTimeSales_77
trial_store = 77
control_store = 233
store_type = []
for i in pastSales_77["STORE_NBR"]:
    if i == trial_store:
        store_type.append("Trial")
    elif i == control_store:
        store_type.append("Control")
    else:
        store_type.append("Other Stores")
pastSales_77["Store_type"] = store_type

# Create a new column 'TransactionMonth'
pastSales_77["TransactionMonth"] = pd.to_datetime(pastSales_77["MONTH_ID"], format = "%Y%m")

# select Trial and control store
pastSales_77 = pastSales_77.loc[pastSales_77["Store_type"].isin(["Control","Trial"])]
pastSales_77 = pastSales_77.loc[:,["TransactionMonth", "Store_type","totSales"]]
pastSales_77.head()
```

	TransactionMonth	Store_type	totSales
880	2018-07-01	Trial	296.8
881	2018-08-01	Trial	255.5
882	2018-09-01	Trial	225.2
883	2018-10-01	Trial	204.5
884	2018-11-01	Trial	245.3

Next steps: Generate code with pastSales_77 View recommended plots

```
pastSales_Controls95_77 = pastSales_77[pastSales_77["Store_type"] == "Control"]
pastSales_Controls95_77["totSales"] = pastSales_Controls95_77["totSales"] * (1+(stdDev_77_s*2))
pastSales_Controls95_77["Store_type"] = "Control 95th % confidence interval"
pastSales_Controls95_77 = pastSales_Controls95_77.loc[:,["TransactionMonth", "Store_type","totSales"]]
pastSales_Controls95_77.head()
```

```
<ipython-input-37-ea18642f278b>:2: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_
  pastSales_Controls95_77["totSales"] = pastSales_Controls95_77["totSales"] * (1+(stdDev
<ipython-input-37-ea18642f278b>:3: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_
  pastSales_Controls95_77["Store_type"] = "Control 95th % confidence interval"
```

	TransactionMonth	Store_type	totSales
2699	2018-07-01	Control 95th % confidence interval	319.735559
2700	2018-08-01	Control 95th % confidence interval	314.456128
2701	2018-09-01	Control 95th % confidence interval	251.432917
2702	2018-10-01	Control 95th % confidence interval	204.247999
2703	2018-11-01	Control 95th % confidence interval	232.734931

Next steps: Generate code with pastSales_Controls95_77 View recommended plots

```
# Control store 5th percentile
pastSales_Controls5_77 = pastSales_77[pastSales_77["Store_type"] == "Control"]
pastSales_Controls5_77["totSales"] = pastSales_Controls95_77["totSales"] * (1-(stdDev_77_s*2))
pastSales_Controls5_77["Store_type"] = "Control 5th % confidence interval"
pastSales_Controls5_77 = pastSales_Controls5_77.loc[:,["TransactionMonth", "Store_type","totSales"]]
pastSales_Controls5_77.head()
```

```
<ipython-input-38-d0273a508d10>:3: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_
  pastSales_Controls5_77["totSales"] = pastSales_Controls95_77["totSales"] * (1-(stdDev_
<ipython-input-38-d0273a508d10>:4: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_
  pastSales_Controls5_77["Store_type"] = "Control 5th % confidence interval"
```

	TransactionMonth	Store_type	totSales
2699	2018-07-01	Control 5th % confidence interval	287.799884
2700	2018-08-01	Control 5th % confidence interval	283.047770
2701	2018-09-01	Control 5th % confidence interval	226.319413
2702	2018-10-01	Control 5th % confidence interval	183.847398
2703	2018-11-01	Control 5th % confidence interval	209.489011

Next steps: Generate code with pastSales_Controls5_77 View recommended plots

```
# Merge 3 tables above together
trialAssessment_77_s = pd.concat([pastSales_77, pastSales_Controls95_77, pastSales_Controls5_77])
trialAssessment_77_s.head()
```

	TransactionMonth	Store_type	totSales
880	2018-07-01	Trial	296.8
881	2018-08-01	Trial	255.5
882	2018-09-01	Trial	225.2
883	2018-10-01	Trial	204.5
884	2018-11-01	Trial	245.3

Next steps: Generate code with trialAssessment_77_s View recommended plots

```
# Plotting these in one nice graph
# Dataset for barplot
bar_77_s = trialAssessment_77_s
bar_77_s["TransactionMonth"] = bar_77_s["TransactionMonth"].dt.strftime("%Y-%m").astype("str")
bar_77_s = bar_77_s.set_index("TransactionMonth")
bar_77_s = bar_77_s.iloc[:24,:]
bar_77_s.head()
```

TransactionMonth	Store_type	totSales
2018-07	Trial	296.8
2018-08	Trial	255.5
2018-09	Trial	225.2
2018-10	Trial	204.5
2018-11	Trial	245.3

Next steps: Generate code with bar_77_s View recommended plots

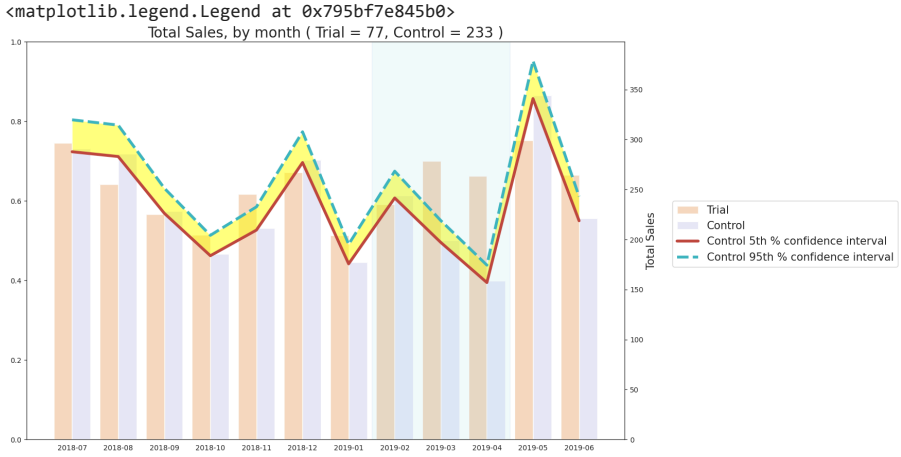
```
line_77_s = trialAssessment_77_s.set_index(["TransactionMonth","Store_type"])["totSales"].unstack()
line_77_s = line_77_s.iloc[:,[1,2]]
line_77_s.head()
```

TransactionMonth	Store_type	Control 5th % confidence interval	Control 95th % confidence interval
2018-07		287.799884	319.735559
2018-08		283.047770	314.456128
2018-09		226.319413	251.432917
2018-10		183.847398	204.247999
2018-11		209.489011	232.734931

Next steps: Generate code with line_77_s View recommended plots

```
# Plotting
fig, ax1 = plt.subplots(1, 1, figsize=(15,10))
ax2 = ax1.twinx()
ax1 = sns.barplot(x=bar_77_s.index, y=bar_77_s["totSales"], hue=bar_77_s["Store_type"], data=bar_77_s,
                  palette=["peachpuff","lavender"])
ax2 = sns.lineplot(data=line_77_s, linewidth=4, palette=sns.hls_palette(2, l=.5, s=.5))
# Yellow shadow to show values between 5% and 95% confidence
ax2.fill_between(line_77_s.index,
                 line_77_s["Control 5th % confidence interval"], line_77_s["Control 95th % confidence interval"],
                 facecolor="yellow", alpha=0.5)
# blue shadow to show trial period
plt.axvspan(xmin=6.5, xmax=9.5, color = 'skyblue', alpha = 0.1)
plt.title("Total Sales, by month ( Trial = 77, Control = 233 )",fontsize=20)
plt.xlabel("Month of Operation",fontsize=15)
plt.ylabel("Total Sales", fontsize=15)
plt.legend(fontsize=15, bbox_to_anchor=(1.08,0.6),borderaxespad = 0.)
```

```
<matplotlib.legend.Legend at 0x795bf7e845b0>
```



(2) Store 86

```
scalingControlSales_86 = (preTrialMeasures[preTrialMeasures["STORE_NBR"] == 86]["totSales"].sum()) / (preTrialMeasures[preTrialMeasures["STC
#scalingControlSales_86

# Apply the scaling factor
scaledControlSales_86 = measure_over_time[measure_over_time["STORE_NBR"]== 155]
scaledControlSales_86["controlSales"] = scaledControlSales_86["totSales"] * scalingControlSales_86
```

```
<ipython-input-48-d26530ccfafe>:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-cc
  scaledControlSales_86["controlSales"] = scaledControlSales_86["totSales"] * scalingControlSales_86
```

```
# Calculate the percentage difference between scaled control sales and trial sales
trialSales_86 = measure_over_time[measure_over_time["STORE_NBR"]== 86].reset_index(drop=True)
scaledControlSales_86 = scaledControlSales_86.reset_index(drop=True)
percentageDiff_86_s = pd.concat([trialSales_86["MONTH_ID"],trialSales_86["totSales"],scaledControlSales_86["controlSales"]],axis=1)
percentageDiff_86_s.columns=["MONTH_ID","trialSales","controlSales"]
percentageDiff_86_s["percentageDiff"]= (abs(percentageDiff_86_s["trialSales"]-percentageDiff_86_s["controlSales"]))/percentageDiff_86_s["con


dof = 7
# standard deviation of percentage difference in pre-trail period
stdDev_86_s = percentageDiff_86_s[percentageDiff_86_s["MONTH_ID"]<201902]["percentageDiff"].std()
stdDev_86_s
```

```
0.025833952854772368
```

```
# Calculate the t-values for the trial months.
percentageDiff_86_s["tValue"] = (percentageDiff_86_s["percentageDiff"]-0)/stdDev_86_s
percentageDiff_86_s.head()
```

	MONTH_ID	trialSales	controlSales	percentageDiff	tValue
0	201807	892.20	896.922236	0.005265	0.203799
1	201808	764.05	759.269991	0.006296	0.243692
2	201809	914.60	984.034086	0.070561	2.731315
3	201810	948.40	934.948790	0.014387	0.556907
4	201811	918.00	871.894555	0.052880	2.046904

Next steps: Generate code with percentageDiff_86_s View recommended plots

```
measureOverTimeSales_86 = measure_over_time
pastSales_86 = measureOverTimeSales_86
trial_store = 86
control_store = 155
store_type = []
for i in pastSales_86["STORE_NBR"]:
    if i == trial_store:
        store_type.append("Trial")
    elif i == control_store:
        store_type.append("Control")
    else:
        store_type.append("Other Stores")
pastSales_86["Store_type"] = store_type

# Create a new column 'TransactionMonth'
pastSales_86["TransactionMonth"] = pd.to_datetime(pastSales_86["MONTH_ID"], format = "%Y%m")

# select Trial and control store
pastSales_86 = pastSales_86.loc[pastSales_86["Store_type"].isin(["Control","Trial"])]
pastSales_86 = pastSales_86.loc[:,["TransactionMonth", "Store_type","totSales"]]


pastSales_Controls95_86 = pastSales_86[pastSales_86["Store_type"] == "Control"]
pastSales_Controls95_86["totSales"] = pastSales_Controls95_86["totSales"] * (1+(stdDev_86_s*2))
pastSales_Controls95_86["Store_type"] = "Control 95th % confidence interval"
pastSales_Controls95_86 = pastSales_Controls95_86.loc[:,["TransactionMonth", "Store_type","totSales"]]
```

```
<ipython-input-54-beb728988338>:2: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-cc
  pastSales_Controls95_86["totSales"] = pastSales_Controls95_86["totSales"] * (1+(stdDev_86_s*2))
<ipython-input-54-beb728988338>:3: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead
```