In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from scipy.stats import ttest_ind
```

THREE STORES 77,86 AND 88 HAVE BEEN SELECTED AS TRIAL STORES FOR PERIOD FEB 2019 TO APRIL 2019, NOW WE NEED TO SELECT CONTROL STORES FOR TRIAL STORES WHICH FOLLOW SIMILAR TRAJECTORY, SO THAT IMPACT OF TRIAL LAYOUT ORGANIZED IN SAID PERIOD CAN BE PROPERLY ANALYSED.

In [2]:
```
raw_data = pd.read_csv("Sales Data Merged and Preprocessed.csv")
```

In [3]:
```
df= raw_data.copy()
df.head()
```

Out[3]:

	DATE	STORE_NBR	LYLTY_CARD_NBR	TXN_ID	PROD_NBR	PROD_NAME	PROD_QTY	TOT_SALES	PACK_SIZE(g)	BRAND_NAME	LIFESTAGE	PREMIUM_CUSTOMER
0	2018-10-19	1	1000	1	5	Natural Chip Compny SeaSalt175g	2	6.0	175	Natural	YOUNG SINGLES/COUPLES	Premium
1	2019-05-16	1	1307	348	66	CCs Nacho Cheese 175g	3	6.3	175	CCs	MIDAGE SINGLES/COUPLES	Budget
2	2019-05-22	1	1343	383	61	Smiths Crinkle Cut Chips Chicken 170g	2	2.9	170	Smiths	MIDAGE SINGLES/COUPLES	Budget
3	2018-08-19	2	2373	974	69	Smiths Chip Thinly S/Cream&Onion 175g	5	15.0	175	Smiths	MIDAGE SINGLES/COUPLES	Budget
4	2018-08-20	2	2426	1038	108	Kettle Tortilla ChpsHny&Jlpno Chili 150g	3	13.8	150	Kettle	MIDAGE SINGLES/COUPLES	Budget

In [4]:
```
df = df.iloc[:,[2,0,1,4,5,6,3,9,8,10,11,7]]
df.head()
```

Out[4]:

	LYLTY_CARD_NBR	DATE	STORE_NBR	PROD_NBR	PROD_NAME	PROD_QTY	TXN_ID	BRAND_NAME	PACK_SIZE(g)	LIFESTAGE	PREMIUM_CUSTOMER	TOT_SALES
0	1000	2018-10-19	1	5	Natural Chip Compny SeaSalt175g	2	1	Natural	175	YOUNG SINGLES/COUPLES	Premium	6.0
1	1307	2019-05-16	1	66	CCs Nacho Cheese 175g	3	348	CCs	175	MIDAGE SINGLES/COUPLES	Budget	6.3
2	1343	2019-05-22	1	61	Smiths Crinkle Cut Chips Chicken 170g	2	383	Smiths	170	MIDAGE SINGLES/COUPLES	Budget	2.9
3	2373	2018-08-19	2	69	Smiths Chip Thinly S/Cream&Onion 175g	5	974	Smiths	175	MIDAGE SINGLES/COUPLES	Budget	15.0
4	2426	2018-08-20	2	108	Kettle Tortilla ChpsHny&Jlpno Chili 150g	3	1038	Kettle	150	MIDAGE SINGLES/COUPLES	Budget	13.8

In [5]:
```
df['STORE_NBR'].unique()
```

Out[5]:
```
array([  1,   2,   4,   5,   7,   8,   9,  13,  19,  20,  22,  23,  25,
        33,  36,  38,  39,  41,  43,  45,  51,  54,  55,  56,  58,  59,
        60,  62,  63,  67,  71,  72,  74,  75,  80,  81,  82,  83,  84,
        88,  94,  96,  97, 101, 102, 104, 106, 109, 110, 111, 112, 114,
       115, 116, 118, 119, 120, 122, 125, 128, 129, 130, 133, 149, 151,
       152, 153, 156, 157, 160, 161, 164, 166, 167, 168, 169, 172, 173,
       175, 178, 181, 184, 186, 187, 191, 194, 196, 197, 200, 205, 207,
       208, 209, 212, 214, 215, 216, 217, 219, 222, 223, 225, 226, 227,
       235, 236, 237, 241, 243, 246, 247, 248, 250, 253, 255, 256, 257,
       262, 265, 266, 269, 271,  77,   3,   6,  10,  12,  15,  16,  17,
        18,  21,  24,  26,  27,  28,  29,  30,  32,  34,  35,  37,  40,
        46,  47,  48,  49,  50,  52,  53,  57,  61,  64,  65,  66,  68,
        69,  70,  73,  78,  79,  86,  87,  89,  90,  91,  93,  95,  98,
       100, 103, 105, 107, 108, 113, 117, 121, 123, 124, 126, 127, 131,
       132, 134, 135, 136, 137, 138, 140, 141, 142, 143, 144, 145, 147,
       148, 150, 154, 155, 158, 162, 163, 165, 170, 171, 174, 176, 177,
       179, 180, 182, 183, 185, 188, 189, 190, 192, 195, 199, 201, 202,
       203, 210, 213, 218, 220, 221, 224, 228, 229, 230, 231, 232, 233,
       234, 238, 239, 240, 242, 244, 245, 249, 251, 254, 259, 260, 261,
       263, 264, 267, 268, 270, 272,  14,  42,  44,  92,  99, 139, 146,
       159, 198, 204, 258, 211,  31,  85,  76,  11, 252, 193, 206])
```

In [6]:
```
df.loc[df['STORE_NBR']== 77][['DATE','PROD_QTY','TOT_SALES']]
```

Out[6]:

	DATE	PROD_QTY	TOT_SALES
202	2019-06-19	2	8.4
1438	2019-03-30	1	3.3
1439	2019-04-15	1	3.0
1440	2018-07-19	1	2.3
1441	2019-03-05	2	8.4
...	...	...	...
263914	2018-07-24	1	2.1
263920	2018-09-30	2	3.8
263922	2018-09-20	2	5.4
263928	2018-07-31	2	5.4
263932	2018-11-09	2	3.8

563 rows × 3 columns

In [7]:
```
#Converting date column from string to datetime column
df['DATE'] = pd.to_datetime(df['DATE'])
```

In [8]:
```
df['Month'] = df['DATE'].dt.month_name()
```

In [9]:
```
df['Year'] = df['DATE'].dt.year
```

In [10]:
```
df['Month'].value_counts()
```

Out[10]:
```
Month
December     22853
March        22628
July         22571
August       22487
May          22403
October      22342
January      22143
November     21798
June         21797
April        21727
September    21673
February     20412
Name: count, dtype: int64
```

In [11]:
```
df['DATE'].sort_values(ascending = False)
```

Out[11]:
```
177002   2019-07-02
40823    2019-07-02
264142   2019-07-02
183722   2019-07-02
261274   2019-07-02
            ...
203757   2018-07-03
230715   2018-07-03
158469   2018-07-03
103273   2018-07-03
72228    2018-07-03
Name: DATE, Length: 264834, dtype: datetime64[ns]
```

In [12]:
```
df.head()
```

Out[12]:

	LYLTY_CARD_NBR	DATE	STORE_NBR	PROD_NBR	PROD_NAME	PROD_QTY	TXN_ID	BRAND_NAME	PACK_SIZE(g)	LIFESTAGE	PREMIUM_CUSTOMER	TOT_SALES	Month	Year
0	1000	2018-10-19	1	5	Natural Chip Compny SeaSalt175g	2	1	Natural	175	YOUNG SINGLES/COUPLES	Premium	6.0	October	2018
1	1307	2019-05-16	1	66	CCs Nacho Cheese 175g	3	348	CCs	175	MIDAGE SINGLES/COUPLES	Budget	6.3	May	2019
2	1343	2019-05-22	1	61	Smiths Crinkle Cut Chips Chicken 170g	2	383	Smiths	170	MIDAGE SINGLES/COUPLES	Budget	2.9	May	2019
3	2373	2018-08-19	2	69	Smiths Chip Thinly S/Cream&Onion 175g	5	974	Smiths	175	MIDAGE SINGLES/COUPLES	Budget	15.0	August	2018
4	2426	2018-08-20	2	108	Kettle Tortilla ChpsHny&Jlpno Chili 150g	3	1038	Kettle	150	MIDAGE SINGLES/COUPLES	Budget	13.8	August	2018

CHARACTERISTICS OF TRIAL STORES 77, 86 AND 88

In [13]:
```
monthly_store_77 = df.loc[df['STORE_NBR']== 77][['Month','PROD_QTY','TOT_SALES']]
```

In [14]:
```
monthly_store_77.groupby('Month').sum().mean()
```

Out[14]:
```
PROD_QTY      72.666667
TOT_SALES    253.333333
dtype: float64
```

In [15]:
```
df.loc[df['STORE_NBR']== 77]['LYLTY_CARD_NBR'].nunique()
```

Out[15]:
```
356
```

In store 77 - monthly average sale is 253 and quantity ordered is 72.66 with total yearly transanctions are 563 and total customers are 356 total sale is 3040

In [16]:
```
monthly_store_86 = df.loc[df['STORE_NBR']== 86][['Month','PROD_QTY','TOT_SALES']]
```

In [17]:
```
monthly_store_86.groupby('Month').sum().sum()
```

Out[17]:
```
PROD_QTY      3066.00
TOT_SALES    10635.35
dtype: float64
```

In [18]:
```
df.loc[df['STORE_NBR']== 86]['LYLTY_CARD_NBR'].nunique()
```

Out[18]:
```
273
```

IN store 86, monthly average sale is 886(thrice of trial store 77) and quantity ordered is 255(more than thrice of 77) total yearly transactions are 1538 and total unique customers are 273 total sale is 10635

In [19]:
```
monthly_store_88 = df.loc[df['STORE_NBR']== 88][['Month','PROD_QTY','TOT_SALES']]
monthly_store_88.groupby('Month').sum().mean()
```

Out[19]:
```
PROD_QTY      309.833333
TOT_SALES    1361.104167
dtype: float64
```

In [20]:
```
df.loc[df['STORE_NBR']== 88]['LYLTY_CARD_NBR'].nunique()
```

Out[20]:
```
388
```

IN store 88, monthly average sale is 1361(five times of trial store 77) and quantity ordered is 309(more than four times of 77) with total number of transaction are 1873 and total unique customers are 388. total sale is 16333

In [21]:
```
monthly_store_88.head()
```

Out[21]:

	Month	PROD_QTY	TOT_SALES
69	May	2	9.2
1641	September	2	13.0
1642	October	2	7.6
1643	February	2	10.8
1644	May	2	8.8

WE NEED TO FIND CONTROL STORES WHICH HAVE SIMILAR BEHAVIOUR IN OUR ANALYSIS TO HAVE THE TRIAL TO BE EXECUTED THERE.

In [22]:
```
df.head()
```

Out[22]:

	LYLTY_CARD_NBR	DATE	STORE_NBR	PROD_NBR	PROD_NAME	PROD_QTY	TXN_ID	BRAND_NAME	PACK_SIZE(g)	LIFESTAGE	PREMIUM_CUSTOMER	TOT_SALES	Month	Year
0	1000	2018-10-19	1	5	Natural Chip Compny SeaSalt175g	2	1	Natural	175	YOUNG SINGLES/COUPLES	Premium	6.0	October	2018
1	1307	2019-05-16	1	66	CCs Nacho Cheese 175g	3	348	CCs	175	MIDAGE SINGLES/COUPLES	Budget	6.3	May	2019
2	1343	2019-05-22	1	61	Smiths Crinkle Cut Chips Chicken 170g	2	383	Smiths	170	MIDAGE SINGLES/COUPLES	Budget	2.9	May	2019
3	2373	2018-08-19	2	69	Smiths Chip Thinly S/Cream&Onion 175g	5	974	Smiths	175	MIDAGE SINGLES/COUPLES	Budget	15.0	August	2018
4	2426	2018-08-20	2	108	Kettle Tortilla ChpsHny&Jlpno Chili 150g	3	1038	Kettle	150	MIDAGE SINGLES/COUPLES	Budget	13.8	August	2018

In [23]:
```
control_store_data = df.groupby(['STORE_NBR','Month'])[['PROD_QTY','TOT_SALES']].sum()
control_store_data
```

Out[23]:

		PROD_QTY	TOT_SALES
STORE_NBR	**Month**		
1	**April**	59	194.6
	August	59	199.6
	December	63	204.9
	February	63	224.5
	January	41	150.9
...	**...**	...	...
272	**March**	97	425.7
	May	77	338.2
	November	87	376.2
	October	95	414.2
	September	75	324.1

3169 rows × 2 columns

In [24]:
```
control_store_data=control_store_data.reset_index()
```

In [25]:
```
df['YEARMONTH'] = df['DATE'].dt.to_period('M')
```

In [26]:
```
df.head()
```

Out[26]:

	LYLTY_CARD_NBR	DATE	STORE_NBR	PROD_NBR	PROD_NAME	PROD_QTY	TXN_ID	BRAND_NAME	PACK_SIZE(g)	LIFESTAGE	PREMIUM_CUSTOMER	TOT_SALES	Month	Year	YEA
0	1000	2018-10-19	1	5	Natural Chip Compny SeaSalt175g	2	1	Natural	175	YOUNG SINGLES/COUPLES	Premium	6.0	October	2018	
1	1307	2019-05-16	1	66	CCs Nacho Cheese 175g	3	348	CCs	175	MIDAGE SINGLES/COUPLES	Budget	6.3	May	2019	
2	1343	2019-05-22	1	61	Smiths Crinkle Cut Chips Chicken 170g	2	383	Smiths	170	MIDAGE SINGLES/COUPLES	Budget	2.9	May	2019	
3	2373	2018-08-19	2	69	Smiths Chip Thinly S/Cream&Onion 175g	5	974	Smiths	175	MIDAGE SINGLES/COUPLES	Budget	15.0	August	2018	
4	2426	2018-08-20	2	108	Kettle Tortilla ChpsHny&Jlpno Chili 150g	3	1038	Kettle	150	MIDAGE SINGLES/COUPLES	Budget	13.8	August	2018	

In [27]:
```
#setting trial period from feb 2019-april 2019
trial_start = pd.Period('2019-02', freq = 'M')
trial_end = pd.Period('2019-04', freq = 'M')
pre_trial_end = trial_start - 1
pre_trial_start = pd.Period('07-2018', freq = 'M')
```

In [28]:
```
monthly = df.groupby(['YEARMONTH', 'STORE_NBR']).agg(
                    TOT_SALE = ('TOT_SALES','sum'),
                    CUSTOMERS = ('LYLTY_CARD_NBR','nunique')).reset_index()
monthly.head()
```

Out[28]:

	YEARMONTH	STORE_NBR	TOT_SALE	CUSTOMERS
0	2018-07	1	183.4	46
1	2018-07	2	141.2	36
2	2018-07	3	1140.1	106
3	2018-07	4	1326.5	122
4	2018-07	5	776.2	90

In [29]:
```
monthly['AVG_SALE_PER_CUST'] = monthly['TOT_SALE'] / monthly['CUSTOMERS']
```

In [30]:
```
monthly[monthly['STORE_NBR']==1]
```

Out[30]:

	YEARMONTH	STORE_NBR	TOT_SALE	CUSTOMERS	AVG_SALE_PER_CUST
0	2018-07	1	183.4	46	3.986957
266	2018-08	1	199.6	46	4.339130
529	2018-09	1	258.7	56	4.619643
793	2018-10	1	201.7	44	4.584091
1058	2018-11	1	179.6	42	4.276190
1322	2018-12	1	204.9	46	4.454348
1585	2019-01	1	150.9	35	4.311429
1848	2019-02	1	224.5	51	4.401961
2112	2019-03	1	193.7	46	4.210870
2377	2019-04	1	194.6	43	4.525581
2642	2019-05	1	214.4	43	4.986047
2905	2019-06	1	159.0	41	3.878049
3169	2019-07	1	28.6	4	7.150000

In [31]:
```
pre = monthly[(monthly['YEARMONTH'] >= pre_trial_start) & (monthly['YEARMONTH'] <= pre_trial_end)].copy()

store_df1 = (
    pre.groupby('STORE_NBR')
       .agg(TOTAL_SALE=('TOT_SALE','sum'),
            AVG_SALE_MONTHLY=('TOT_SALE','mean'),
            AVG_SALE_PER_CUST=('AVG_SALE_PER_CUST','mean'),
            AVG_CUST_MONTHLY=('CUSTOMERS','mean'))
       .reset_index()
)
```

In [32]:
```
store_df1.head() # monthly analysis of all stores in pre trial period.
```

Out[32]:

	STORE_NBR	TOTAL_SALE	AVG_SALE_MONTHLY	AVG_SALE_PER_CUST	AVG_CUST_MONTHLY
0	1	1378.80	196.971429	4.367398	45.000000
1	2	1124.30	160.614286	4.149788	38.714286
2	3	7443.75	1063.392857	10.010493	106.285714
3	4	8995.60	1285.085714	10.694143	120.142857
4	5	5657.50	808.214286	8.756733	92.428571

In [33]:
```
monthly
```

Out[33]:

	YEARMONTH	STORE_NBR	TOT_SALE	CUSTOMERS	AVG_SALE_PER_CUST
0	2018-07	1	183.4	46	3.986957
1	2018-07	2	141.2	36	3.922222
2	2018-07	3	1140.1	106	10.755660
3	2018-07	4	1326.5	122	10.872951
4	2018-07	5	776.2	90	8.624444
...	...	...	...	...	...
3411	2019-07	268	10.4	2	5.200000
3412	2019-07	269	65.2	8	8.150000
3413	2019-07	270	32.2	4	8.050000
3414	2019-07	271	76.4	11	6.945455
3415	2019-07	272	16.8	2	8.400000

3416 rows × 5 columns

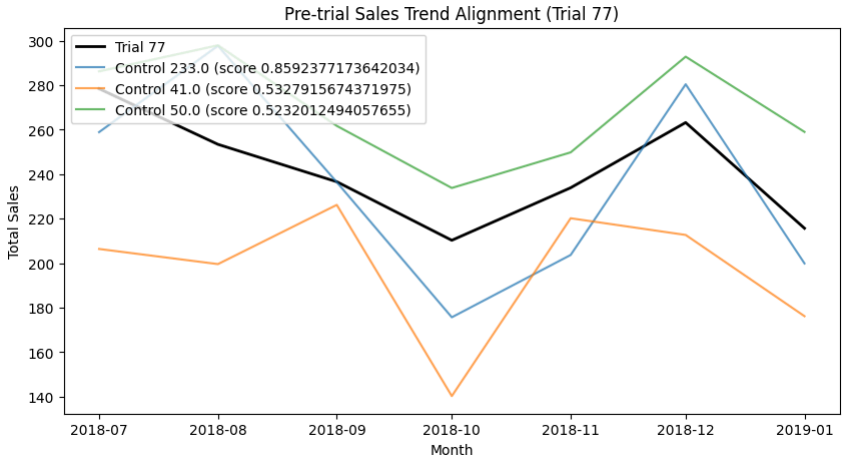
In [34]:
```
#A FUNCTION WHICH SELECT CONTROL STORES BASED ON CORREALTION AND RELATIVE PERCENTAGE DIFFERENCE
def store_selection_before_trial(trial_store,monthly, pre_start,pre_end,top_n):
    pre = monthly[(monthly['YEARMONTH']>= pre_start) & (monthly['YEARMONTH']<= pre_end)] # pre-trial period data

    #getting trial_store data for pre-trial period
    trial_data = pre[pre['STORE_NBR'] == trial_store].set_index('YEARMONTH')[['TOT_SALE','CUSTOMERS']]


    #getting candidate data for pre-trial period
    #first - getting candidates customer number
    cand_df = pre[['STORE_NBR']].drop_duplicates()
    cand_df = cand_df['STORE_NBR'].tolist()
    cand_list = [c for c in cand_df if c!= trial_store]
    results = []
    for c in cand_list:
        cand_data = pre[pre['STORE_NBR'] == c].set_index('YEARMONTH')[['TOT_SALE','CUSTOMERS']]
        merged = trial_data.join(cand_data, how = 'inner', lsuffix = '_TRIAL', rsuffix = '_CAND')

        if len(merged)<4: # minimum overlap of 4 months
            continue

        #calculating correlation between candidate and trial stores
        corr_cust = merged['CUSTOMERS_TRIAL'].corr(merged['CUSTOMERS_CAND'])
        corr_sale = merged['TOT_SALE_TRIAL'].corr(merged['TOT_SALE_CAND'])

        #calculating relative difference between trial and candidate stores
        diff_cust = abs(merged['CUSTOMERS_TRIAL'].mean() - merged['CUSTOMERS_CAND'].mean()) / merged['CUSTOMERS_TRIAL'].mean()
        diff_sale = abs(merged['TOT_SALE_TRIAL'].mean() - merged['TOT_SALE_CAND'].mean()) / merged['TOT_SALE_TRIAL'].mean()

        #final score of candidate store
        score = ((corr_cust or 0) + (corr_sale or 0)) / 2 - (diff_cust+diff_sale)/ 2

        #creating list of all calculations
        results.append({
            'STORE_NBR': c,
            'CORR_SALES': corr_sale,
            'CORR_CUSTOMERS': corr_cust,
            'DIFF_SALES': diff_sale,
            'DIFF_CUSTOMERS': diff_cust,
            'SCORE': score
        })
```

```
    #converting list into a dataframe and returning the top n rows for candidates based on scores.
    res = pd.DataFrame(results).sort_values('SCORE', ascending = False)
    return res.head(top_n), res
```

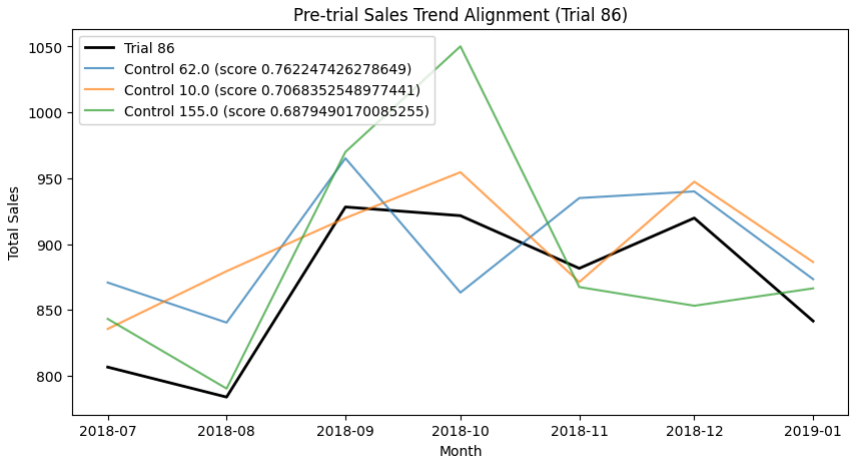
In [35]:
```
#FUNCTION WHICH PLOTS THE TRIAL STORE AND TOP 3 SELECTED CONTROL STORES FOR EACH STORE FOR PRE-TRIAL PERIOD
def plot_pretrial_trends(trial_store, top_df, monthly, pre_start, pre_end):
    pre = monthly[(monthly['YEARMONTH'] >= pre_start) & (monthly['YEARMONTH'] <= pre_end)].copy()
     # Ensure YEARMONTH is in datetime (for plotting)
    if isinstance(pre['YEARMONTH'].iloc[0], pd.Period):
        pre['YEARMONTH'] = pre['YEARMONTH'].dt.to_timestamp()

    trial_data = pre[pre['STORE_NBR'] == trial_store].set_index('YEARMONTH')

    plt.figure(figsize=(10,5))
    plt.plot(trial_data.index, trial_data['TOT_SALE'], label=f"Trial {trial_store}", linewidth=2, color="black")

    for _, row in top_df.iterrows():
        cand_store = row['STORE_NBR']
        cand_data = pre[pre['STORE_NBR'] == cand_store].set_index('YEARMONTH')
        plt.plot(cand_data.index, cand_data['TOT_SALE'], label=f"Control {cand_store} (score {row['SCORE']})", alpha=0.7)

    plt.title(f"Pre-trial Sales Trend Alignment (Trial {trial_store})")
    plt.xlabel("Month")
    plt.ylabel("Total Sales")
    plt.legend(loc ='upper left' )
    plt.show()
```

In [36]:
```
(top_77, all_77) = store_selection_before_trial(77, monthly, pre_trial_start, pre_trial_end, top_n=3)
top_86, all_86 = store_selection_before_trial(86, monthly, pre_trial_start, pre_trial_end, top_n=3)
top_88, all_88 = store_selection_before_trial(88, monthly, pre_trial_start, pre_trial_end, top_n=3)
```

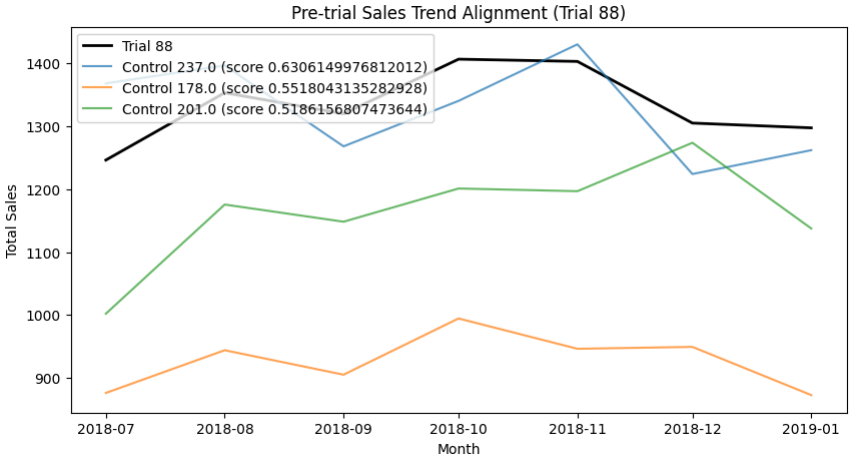
In [37]:
```
top_77 #store 233 as the control store for 77
plot_pretrial_trends(77, top_77, monthly, pre_trial_start, pre_trial_end)
```



In [38]:
```
top_86 # store 62 as control store for 86
plot_pretrial_trends(86, top_86, monthly, pre_trial_start, pre_trial_end)
```



In [39]:
```
top_88 # store 178 as control store for 88
plot_pretrial_trends(88, top_88, monthly, pre_trial_start, pre_trial_end)
```

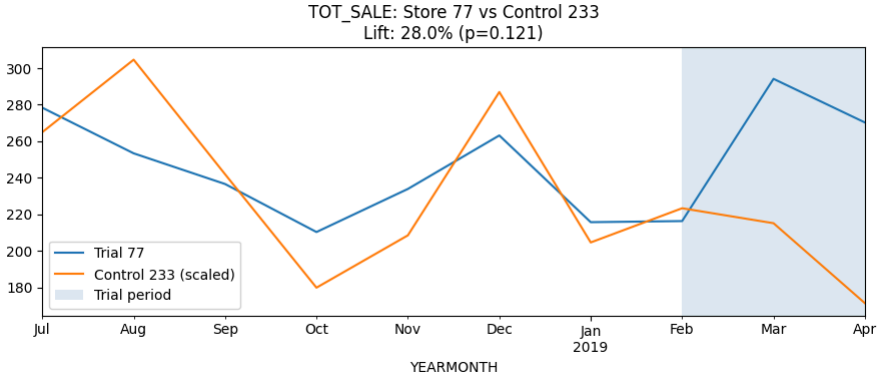


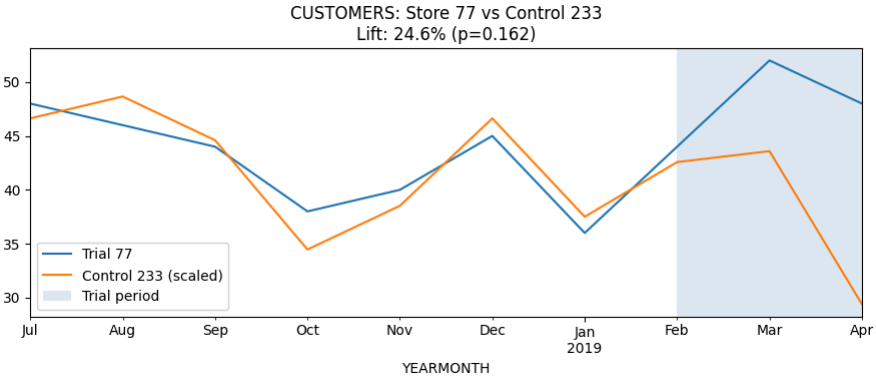
THESE TOP_77, TOP_86, TOP_88 ARE TOP 3 CONTROL STORES SIMILAR TO TRIAL STORES BASED ON THE PRE-TRIAL DATA.

NOW WE WILL LOOK FOR IMPACT OF TRIAL ON TRIAL STORES BY ANALYSING THE CAHNGES IN TOP 3 CONTROL STORES AND TRIAL STORES

In [40]:
```
# FUNCTION WHICH EVALUATE THE PERFORMANCE OF TRIAL STORE BASED ON WELCH T-TEST AND PLOTS THE RESULT
def evaluate_trial(trial_store, control_store, monthly, pre_start, pre_end, trial_start, trial_end, metric):
    # pre-trial series
    pre = monthly[(monthly['YEARMONTH'] >= pre_start) & (monthly['YEARMONTH'] <= pre_end)]
    trial_pre = pre[pre['STORE_NBR']==trial_store].set_index('YEARMONTH')[metric]
    ctrl_pre  = pre[pre['STORE_NBR']==control_store].set_index('YEARMONTH')[metric]

    # trial-period series
    tp = monthly[(monthly['YEARMONTH'] >= trial_start) & (monthly['YEARMONTH'] <= trial_end)]
    trial_tp = tp[tp['STORE_NBR']==trial_store].set_index('YEARMONTH')[metric]
    ctrl_tp  = tp[tp['STORE_NBR']==control_store].set_index('YEARMONTH')[metric]

    # scale control to match pre-trial level of trial store
    scale = trial_pre.mean() / ctrl_pre.mean()
    ctrl_pre_scaled = ctrl_pre * scale
    ctrl_tp_scaled  = ctrl_tp * scale

    # % lift during trial period
    lift = (trial_tp.mean() - ctrl_tp_scaled.mean()) / ctrl_tp_scaled.mean() * 100

    # simple significance test across monthly points in trial period
    # (Welch t-test on monthly values)
    tstat, pval = ttest_ind(trial_tp.values, ctrl_tp_scaled.values, equal_var=False, nan_policy='omit')

    # quick plot
    plt.figure(figsize=(9,4))
    pd.concat([trial_pre, trial_tp]).sort_index().plot(label=f'Trial {trial_store}')
    pd.concat([ctrl_pre_scaled, ctrl_tp_scaled]).sort_index().plot(label=f'Control {control_store} (scaled)')
    plt.axvspan(trial_start.to_timestamp(), trial_end.to_timestamp(), alpha=0.15, label='Trial period')
    plt.title(f'{metric}: Store {trial_store} vs Control {control_store}\nLift: {lift:.1f}% (p={pval:.3f})')
    plt.legend()
    plt.tight_layout()
    plt.show()
    test_result = []
    test_result.append({
        'trial_store': trial_store,
        'control_store': control_store,
        'metric': metric,
        'lift_pct': lift,
        'p_value': pval,
        'scale_factor': scale,
        't-test': tstat
    })
    return test_result
```

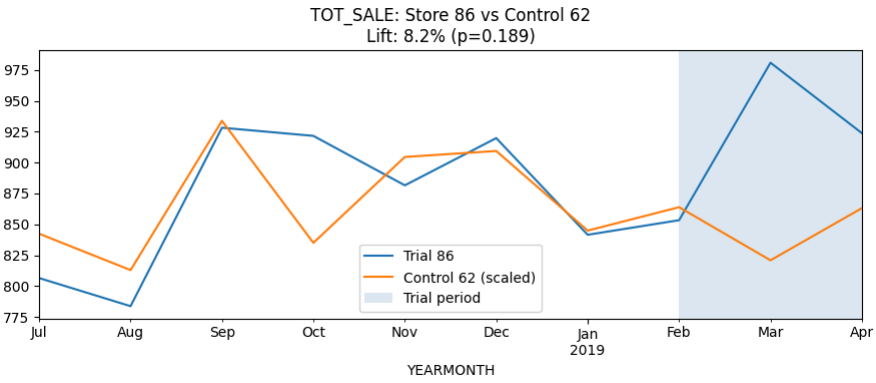
In [41]:
```
best_ctrl_77 = int(top_77.iloc[0]['STORE_NBR'])
eval_77_sales = evaluate_trial(77, 233, monthly, pre_trial_start, pre_trial_end, trial_start, trial_end, metric='TOT_SALE')
eval_77_custs = evaluate_trial(77, best_ctrl_77, monthly,  pre_trial_start, pre_trial_end, trial_start, trial_end, metric='CUSTOMERS')
```

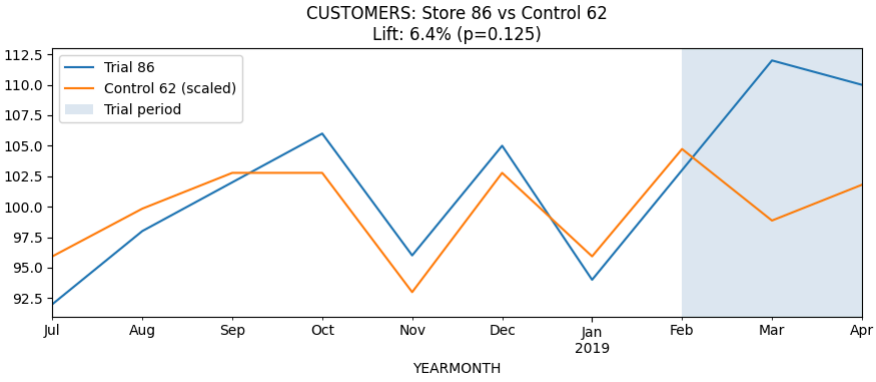




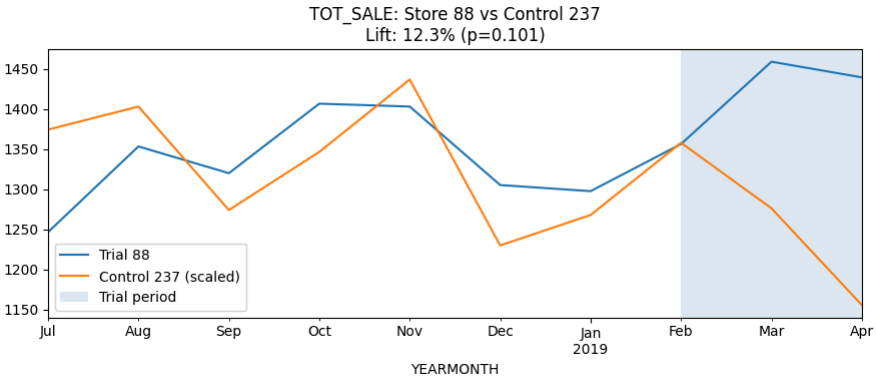
In [ ]:

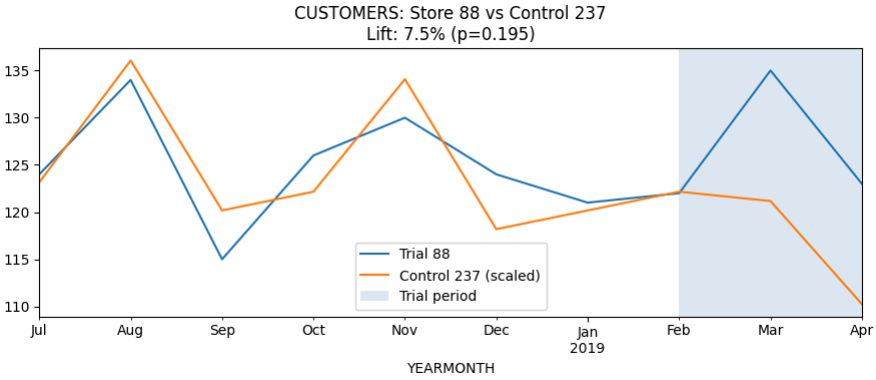
In [42]:
```
best_ctrl_86 = int(top_86.iloc[0]['STORE_NBR'])
eval_86_sales = evaluate_trial(86, best_ctrl_86, monthly, pre_trial_start, pre_trial_end, trial_start, trial_end, metric='TOT_SALE')
eval_86_custs = evaluate_trial(86, best_ctrl_86, monthly,  pre_trial_start, pre_trial_end, trial_start, trial_end, metric='CUSTOMERS')
```





In [43]:
```
best_ctrl_88 = int(top_88.iloc[0]['STORE_NBR'])
eval_88_sales = evaluate_trial(88, best_ctrl_88, monthly, pre_trial_start, pre_trial_end, trial_start, trial_end, metric='TOT_SALE')
eval_88_custs = evaluate_trial(88, best_ctrl_88, monthly,  pre_trial_start, pre_trial_end, trial_start, trial_end, metric='CUSTOMERS')
```





HENCE FROM ABOVE ANALYSIS FOLLOWING INSIGHTS CAN BE DRAWN:

1. TOP CONTROL STORE BASED ON DEFINED METRIC FOR EACH OF TRIAL STORE 77,86 AND 88 ARE 233, 62 AND 178 RESPECTIVELY.

2. BASED ON TOTAL SALES METRIC IT CAN BE CONCLUDED THAT STORE 77 HAD THE MAXIMUM GROWTH SHOWN BY LIFT OFF OF 28% AND STORES 86 AND 88 ALSO SHOWS POSITIVE GROWTH BUT IT IS LESSER COMPARED TO STORE 77. STORE 88 HAS 12.3% AND STORE 86 HAS 8.2% SALE GROWTH.

3. CUSTOMERS METRIC ALSO SHOWS SIMILAR TRENDS AS TOTAL SALES,STORE 77 HAD THE MAXIMUM GROWTH SHOWN BY LIFT OFF OF 24.6% AND STORES 86 AND 88 ALSO SHOWS POSITIVE GROWTH BUT IT IS LESSER COMPARED TO STORE 77. STORE 88 HAS 7.3% AND STORE 86 HAS 6.2% SALE GROWTH.

4. INTERESTING HIGHLIGHT IS THAT IN ALL THE THREE STORES THE NUMBERS INCREASED TILL MARCH MONTH AND IN MARCH TO APRIL IN ALL THREE STORES THEY SAW DECLINES IN NUMBERS.

5. STORE THAT ARE SIMILAR TO STORE 77 HAS HUGE POTENTIAL OF SALES FROM THIS TRIAL LAYOUTS.

6. ALL IN ALL TRIAL LAYOUT IS SUCCESSFUL AND SHOULD BE ROLLED OUT.

In [ ]: