

# Project 5: Analyzing a Market Test

## The Business Problem

Round Roasters is an upscale coffee chain with locations in the western United States of America. The past few years have resulted in stagnant growth at the coffee chain, and a new management team was put in place to reignite growth at their stores.

The first major growth initiative is to introduce gourmet sandwiches to the menu, along with limited wine offerings. The new management team believes that a television advertising campaign is crucial to drive people into the stores with these new offerings.

However, the television campaign will require a significant boost in the company's marketing budget, with an unknown return on investment (ROI). Additionally, there is concern that current customers will not buy into the new menu offerings.

To minimize risk, the management team decides to test the changes in two cities with new television advertising. Denver and Chicago cities were chosen to participate in this test because the stores in these two cities (or markets) perform similarly to all stores across the entire chain of stores; performance in these two markets would be a good proxy to predict how well the updated menu performs.

The test ran for a period of 12 weeks (2016-April-29 to 2016-July-21) where five stores in each of the test markets offered the updated menu along with television advertising.

The comparative period is the test period, but for last year (2015-April-29 to 2015-July-21).

You've been asked to analyze the results of the experiment to determine whether the menu changes should be applied to all stores. The predicted impact to profitability should be enough to justify the increased marketing budget: at least 18% increase in profit growth compared to the comparative period while compared to the control stores; otherwise known as incremental lift. In the data, profit is represented in the `gross_margin` variable.

You have been able to gather three data files to use for your analysis:

Transaction data for all stores from 2015-January-21 to 2016-August-18

- A listing of all Round Roasters stores
- A listing of the 10 stores (5 in each market) that were used as test markets.

## Step 1: Business and Data Understanding

### Key Decisions:

#### 1. What is the performance metric you'll use to evaluate the results of your test?

The performance metric is the increase in gross margin since it will determine whether the television advertising campaign should be rolled out to other cities.

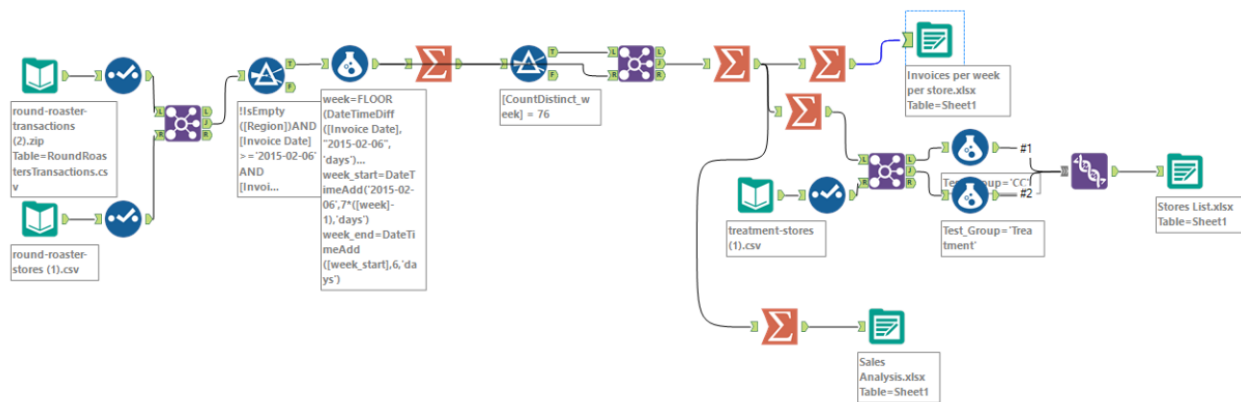
#### 2. What is the test period?

The test period is from 29 April 2016 to 21 July 2016 for 12 weeks periods.

#### 3. At what level (day, week, month, etc.) should the data be aggregated?

The data should be aggregated per weeks.

## Step 2: Clean Up Your Data



For the matched pair A/B testing, we need to

1. **Extract the necessary historical data for the test.** The test period lasted 12 weeks from 29 April 2016 to 21 July 2016. We need to get 1 year and 12 weeks historical data before the test period, i.e. 76 weeks. Therefore, we filtered the data from the transactions sheet for the period of 06 February 2015 to 21 July 2016.
2. **Arrange the data on weekly basis** and consolidate the information per store and week to obtain the weekly store traffic to measure the trend and seasonality.
3. **Create a store list** differentiating the treatment store and control group for the pair matching
4. **Create a sales analysis** consolidating the transactions per region, per store, per week and per weekly sales and gross margin.and store average month sales.

### Step 3: Match Treatment and Control Units

*Apart from trend and seasonality...*

#### 1. What control variables should be considered?

The potential control variables that can be considered are

- The region
- The state
- The city
- The size of the store in sq ft
- The average month sales

#### 2. What is the correlation between your each potential control variable and your performance metric?

#### Testing city, state and region as control variable

As per below grouping extract per city, state and region, we see that city and state do not have enough distinct stores for the control and treatment pair matching, while if we group only by region, there are 42 distinct stores in Central and 91 distinct store in the West. Therefore region is a good control variable for the test.

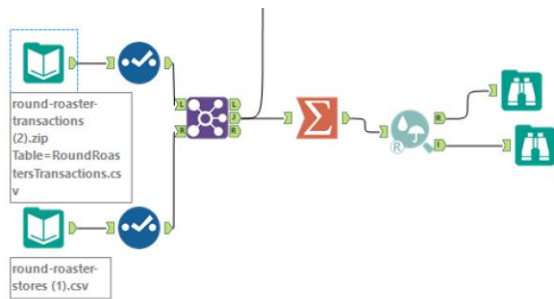
Record #	Region	City	State	CountDistinct_StoreID
1	Central	Altoona	IA	1
2	Central	Amarillo	TX	1
3	Central	Anoka	MN	1
4	Central	Arlington	TX	1
5	Central	Arlington Heights	IL	1
6	Central	Barrington	IL	1
7	Central	Blaine	MN	1
8	Central	Brookfield	WI	1
9	Central	Chesterfield	MO	1
10	Central	Chicago	IL	3
11	Central	Cottage Grove	MN	1
12	Central	Dallas	TX	2
13	Central	Des Moines	IA	1
14	Central	Elk Grove Village	IL	1
15	Central	Fort Worth	TX	1
16	Central	Greendale	WI	1
17	Central	Houston	TX	3
18	Central	Lawrence	KS	1
19	Central	Lockport	IL	1
20	Central	Lucas	TX	1
21	Central	Madison	WI	1
22	Central	Melrose Park	IL	1
23	Central	Mount Prospect	IL	1
24	Central	Nixa	MO	1

Record #	Region	State	CountDistinct_StoreID
1	Central	IA	2
2	Central	IL	15
3	Central	KS	2
4	Central	MN	4
5	Central	MO	4
6	Central	TX	12
7	Central	WI	3
8	West	AZ	10
9	West	CA	42
10	West	CO	15
11	West	ID	2
12	West	NM	2
13	West	NV	2
14	West	OR	8
15	West	WA	10

Record #	Region	CountDistinct_StoreID
1	Central	42
2	West	91

#### Testing sq ft as control variable

To test the correlation between the size of the store in sq ft, we joined the round roaster stores list with the transaction and summarized the information by store, size of the store and sum of gross margin.



After running the association analysis, the correlation between store size and gross margin is -0.02. We conclude that there is no correlation between the store size in sq ft and the gross margin.

## Pearson Correlation Analysis

### Full Correlation Matrix

	Sq_Ft	Sum_Gross.Margin
Sq_Ft	1.000000	-0.020353
Sum_Gross.Margin	-0.020353	1.000000

### Matrix of Corresponding p-values

	Sq_Ft	Sum_Gross.Margin
Sq_Ft		0.81612
Sum_Gross.Margin	0.81612	

### Testing average month sales as control variable

We run the association analysis for average month sales, the correlation between average month sales and gross margin is 0.98. There is a strong correlation, there we should include average month sales as control variable.

## Pearson Correlation Analysis

### Full Correlation Matrix

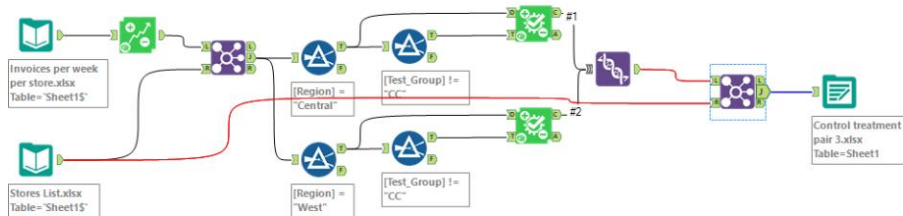
	AvgMonthSales	Sum_Gross.Margin
AvgMonthSales	1.00000	0.98822
Sum_Gross.Margin	0.98822	1.00000

### Matrix of Corresponding p-values

	AvgMonthSales	Sum_Gross.Margin
AvgMonthSales		0
Sum_Gross.Margin	0	

### 3. What control variables will you use to match treatment and control stores?

For the discrete control variable, we will use region as control variable.as well as average monthly sales. For the continuous control variable, we will use weekly number of invoice per store and weekly total gross margin sales per store as a measure of trend and sales seasonality.

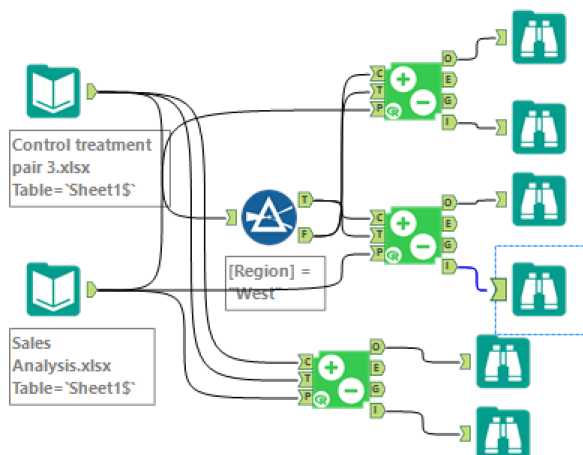


4. Please fill out the table below with your treatment and control stores pairs:

Record #	Controls	Treatments	Distance
1	7162	1664	0.478595
2	8112	1664	1.034443
3	1580	1675	0.45634
4	1807	1675	0.560454
5	1964	1696	0.312367
6	1863	1696	0.489137
7	2014	1700	0.810402
8	1630	1700	0.91618
9	8162	1712	0.671441
10	7434	1712	0.793269
11	9081	2288	0.277932
12	2568	2288	0.714134
13	12219	2293	0.348583
14	9524	2293	0.656038
15	3102	2301	0.381248
16	9238	2301	0.434646
17	2409	2322	0.171431
18	3235	2322	0.45125
19	12536	2341	0.39796
20	2383	2341	0.423792

## Step 4: Analysis and Writeup

We run the analysis on the pair created above on gross margin for the test period from 20 April 2016 to 21 July 2016.

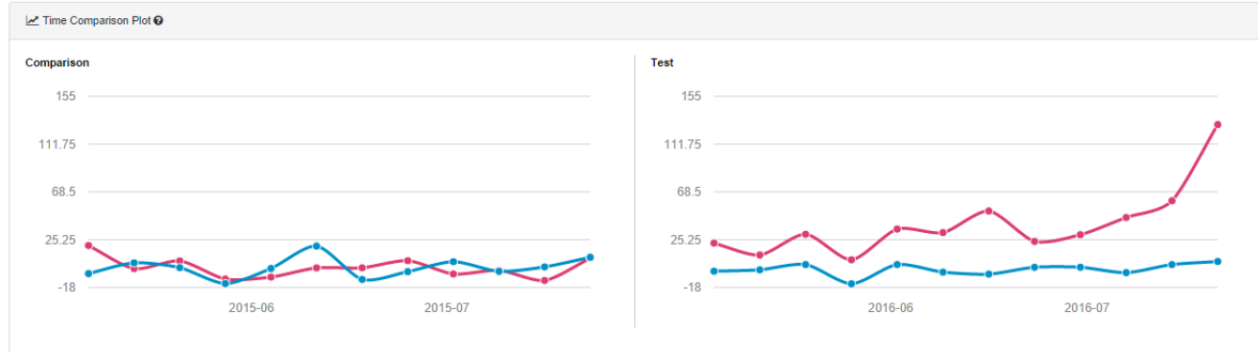
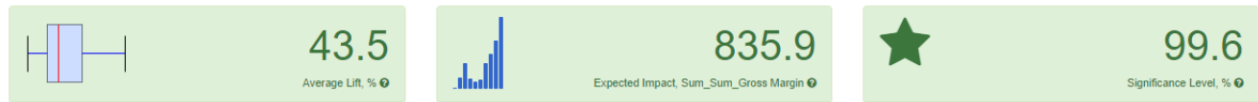


Below are the A/B testing results for

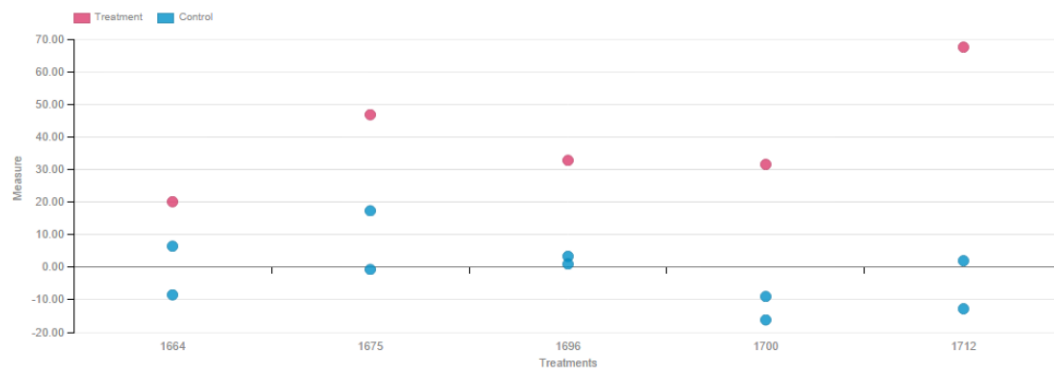
## Central region

### AB Test Analysis for Sum\_Sum\_Gross Margin

Time: 2017-08-01 07:20:25



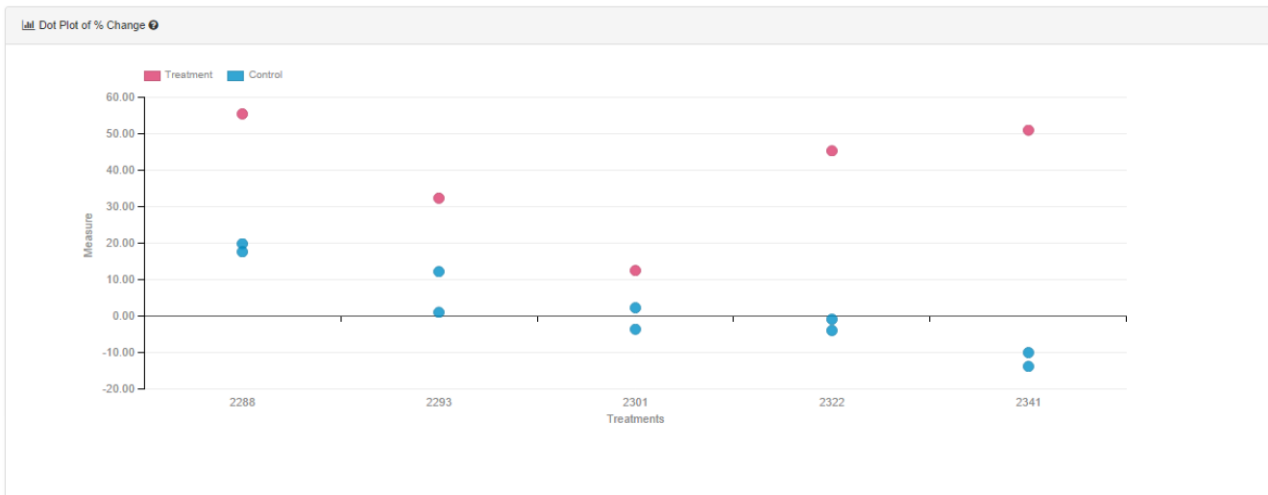
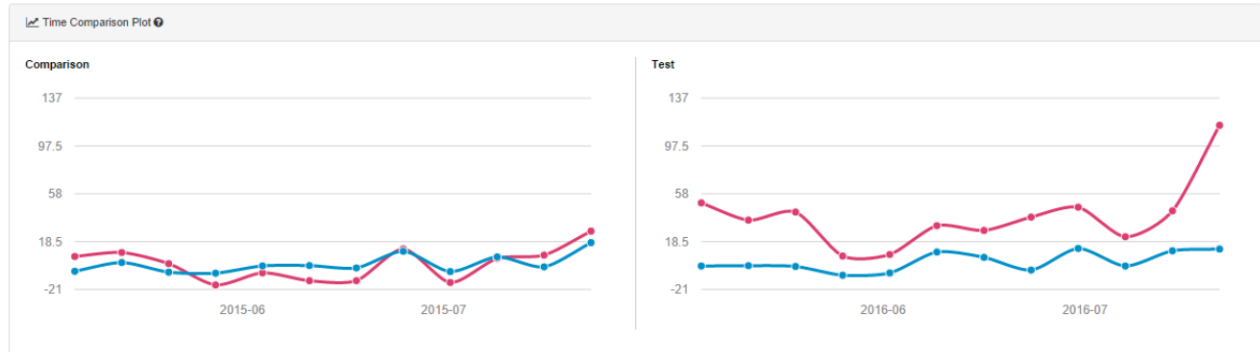
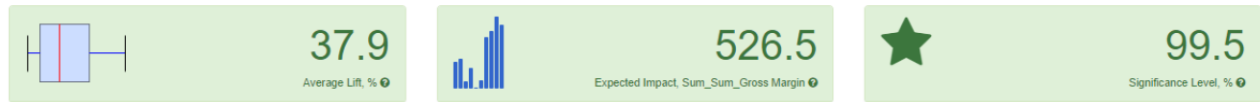
Dot Plot of % Change



## West region

### AB Test Analysis for Sum\_Sum\_Gross Margin

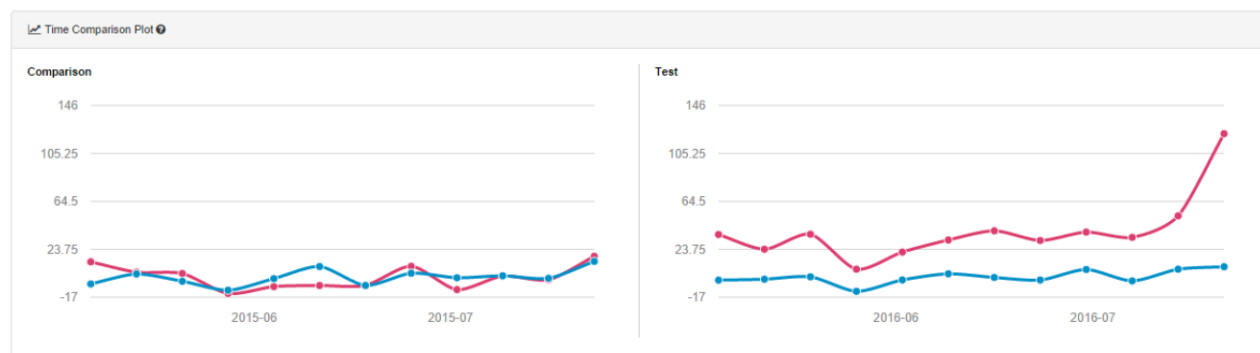
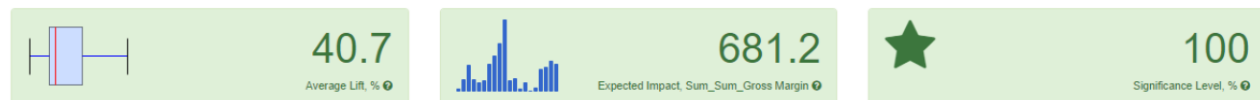
Time: 2017-08-01 07:20:15

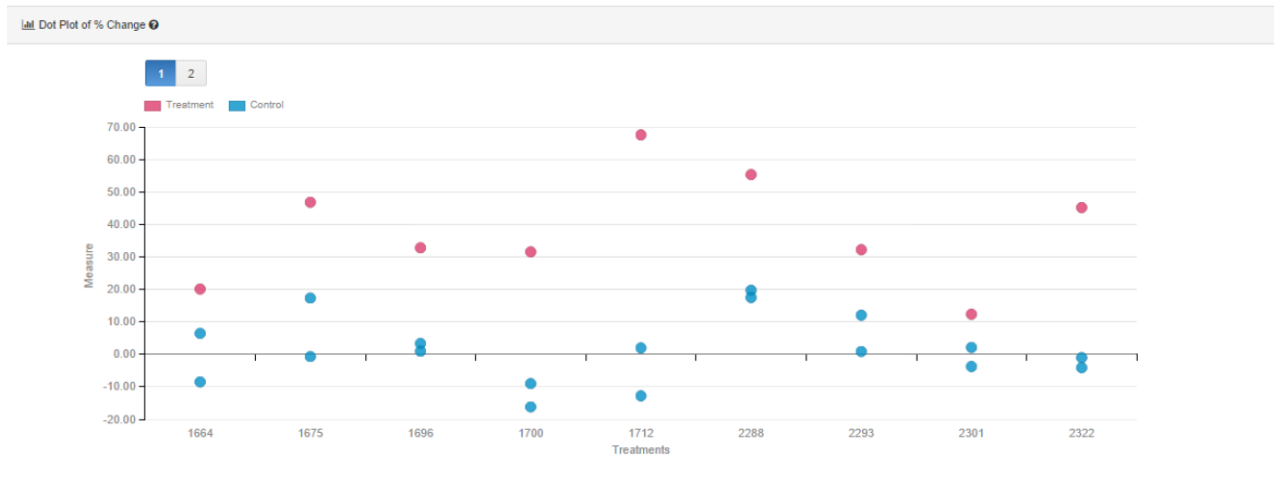


## Overall

### AB Test Analysis for Sum\_Sum\_Gross Margin

Time: 2017-08-01 07:20:35





**1. What is your recommendation - Should the company roll out the updated menu to all stores?**

Based on the above results, the expected increase in gross margin is higher than 18%, therefore the company should roll out the updated menu to all stores.

**2. What is the lift from the new menu for West and Central regions (include statistical significance)?**

The lift from the new menu for West region is 43.5% with a significance level of 99.6%.

The lift from the new menu for Central region is 37.9% with a significance level of 99.5%.

**3. What is the lift from the new menu overall?**

The lift from the new menu overall is 40.7% with a significance level of 100%.

Furthermore, we see from all the comparison charts, that the treatment and control groups have historically similar gross margin before the test, but during the test, the treatment group clearly outperforms the control group.