

## Homework 9

### July 15, 2020

#### Question 19.1

Describe analytics models and data that could be used to make good recommendations to the retailer. How much shelf space should the company have, to maximize their sales or their profit?

#### Part 1: Measurement Plan

To measure the effects of the shelf space optimization outlined in Parts 3 and 4, I recommend selecting groups of stores that are similar to each other and divide them into two groups: test stores and control stores. Selection of these groups is detailed in Part 2. The control group will not have any changes to their current shelf space allocation or their product placement. The test stores will take on the recommended changes in Part 4.

After implementing the changes, it's recommended to wait at least 2 months before measuring performance so that there is enough time to determine that the changes made a lasting impact in purchasing behaviour. Four-point methodology – comparing sales of the products in a two-month pre-period vs the two-month post period in the test and control stores – can be used to determine incremental sales as a result of the shelf space changes.

$$\text{Incr. Sales of Products } i, j = \text{Total Sales of } i, j^{\text{Post}}_{\text{Test}} - \text{Total Sales of } i, j^{\text{Pre}}_{\text{Test}} \times \left( \frac{\text{Total Sales of } i, j^{\text{Post}}_{\text{Ctrl}}}{\text{Total Sales of } i, j^{\text{Pre}}_{\text{Ctrl}}} \right)$$

If incremental sales lift is significant (statistically speaking and in terms of magnitude), then the retailer can start rolling out the changes to the other stores in their network.

#### Part 2: Choose test and control stores

Given	<u>Store Information</u> – square footage, amount of shelf space available, location, region, development class (urban, suburban, rural, etc), annual sales
Use	K-means Clustering
To	Identify groups of stores that share the same attributes

Once the entire store network is separated into clusters, the retailer can choose which cluster(s) to test on. The stores in the selected clusters will randomly be assigned to a test group and control group.

It is at the retailer's discretion to choose which group(s) they feel comfortable testing. Perhaps they don't want to test using the stores with high sales because they don't want to risk their usual level of profit. They also may not want to test the new strategy using stores in rural neighbourhoods if the majority of their network is not located in rural neighbourhoods.

#### Part 3: Find the items that go together

Given	<u>Transaction Data</u> – products purchased, units purchased, category of product, sales and profit from selling products
Use	K-means Clustering
To	Identify pairs of items that are commonly purchased in the same basket

Now that the pairs of products have been determined, rank the pairs based on the amount of sales the products in the pair generates in the given timeframe. Then only choose the top n pairs to optimize shelf space for this test. The number of pairs to choose is for the retailer to decide. They may be comfortable only testing the top 5 pairs or they may choose test product pairs from a certain department. If this test is successful, the retailer can go back and optimize the shelf space for the rest of the product pairs.

#### Part 4: Find the optimal shelf space

Given	<u>Product Pairs</u> – from clustering in Part 3 <u>Store Data</u> – available shelf space, store layout
Use	Fractional Factorial Design
To	To test different variations of shelf space and varying product placement

The retailer can test multiple variations of product placement for each pair by selecting a subset of test stores from the test group for each variation.

#### Example

- Product B will be placed to the right of Product A with a foot of shelf space for each product in test stores 1 and 2
- Product B will be placed to the right of Product A with a 2 feet of shelf space for each product in test stores 3 and 4
- Product A will be placed to the right of Product B with a foot of shelf space for each product in test stores 5 and 6
- Product A will be placed to the right of Product B with a 2 feet of shelf space for each product in test stores 7 and 8
- After the testing period is over, incremental sales for the sets of test stores can be calculated, comparing sales for Product A and B to the control stores.
  - If incremental sales for a set of test stores is significantly higher (statistically and in magnitude), then that combination should be rolled out to the rest of the store network

If the retailer is open to multiple testing periods, the fractional factorial design can be extended into a multi armed bandit where the retailer can test more variations of the amount of shelf space and the placement of the products within the store.