

Week 14 Assignment – Retailer Case

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Table of Contents

Problem Statement.....	2
Problem 1 – What groups go together?	2
Problem 2 – How to measure the effect?	3
Problem 3 – How much space to each group?	4
Problem 4 – Where to locate groups in a store?	5

Problem Statement

The Retailer wants to find out how much shelf space should the company use, to maximize their sales or their profit. Key aspects in this question are:

1. What groups of products should go together?
2. How to measure the effects of these groups having more space?
 - a. This could help confirm the hypothesis that more shelf space for a product causes higher sales or not.
3. How much space these groups of products have on the shelves?
4. Where should these groups be in each store?

Assumptions:

- Hypothesis that more sale of a product causes more sale of complimentary product as well is true (from lecture videos)
- Hypothesis that if complimentary products are closer together, they have a larger effect on the sales is true (from lecture videos)
- Ignoring other factors like
 - Promotions for certain products
 - Some companies pay stores to get more shelf space

Constraints:

- For each product type, the retailer imposed a minimum amount of shelf space required, and a maximum amount that can be devoted
- The physical size of each store means there's a total amount of shelf space that must be used.

Problem 1 – What groups go together?

Key problem to solve here is that what products should go together on shelves. Or what products compliment each other e.g. milk & cookies, Soda & ice, meat and bbq accessories etc.

Data:

- Point of sales data for past one year for the whole network of stores. This data would be available from the retailer database. This data would include
 - Product types and descriptions

- Product quantities purchased
- Time of the day and time of the year when purchase occurred
- Location of purchase

Use:

Exponential smoothing and K-means clustering

To

- Remove seasonal and trend variances in the sales data first. This will help remove summer/ winter effects, effects of promotions and times of day etc.
- Get clusters of products that were purchases together (were in the same receipt a lot). Studying the clusters will help us understand whether some groups are more applicable to certain geographical regions. These would be the groups that could be placed together on shelves.

Problem 2 – How to measure the effect?

Given:

- Subset of product groups from problem 1 to test.
- Max and min space per product on a shelf.
- Selected clusters of stores Nationally with mix in different regions.
- Point of sales data during the test period

Use:

A/B testing

To:

- Test the effect of shelf space on sales by:
 - Splitting stores into 50/50 groups across regions.
 - Putting selected product groups together with more shelf space in 50% of stores and separate with normal space in 50% of stores.
 - Analyzing sales data for a fixed period across all stores to see whether:
 - Stores with groups with more space had more sales of the grouped products

- If the 50% stores without grouped products had higher sales of these groups, it would indicate that there is minimum effect of putting these groups together and with more space.
- Otherwise, the causation of more space for groups would be proven.
- A calculation of effects factor could be calculated for each product group (that how much sales would potentially go up by giving these groups more space).

Problem 3 – How much space to each group?

This exercise would be done at an individual store level.

Given:

- Product groups from problem 1
 - Shelf space available in a store. This could be hard to obtain if retailer does not have it available. Usually as part of the merchandizing exercise, retailers have this data. If not, this could be calculated by:
 - Looking at specifications of each shelf and doing surface area calculations for each shelf.
 - Multiplying that with number of shelves in a store.
- Total space = surface area on each shelf (calculated) x total shelves in a store
- Effects on sales by placing groups together with more space from problem 2.
 - Maximum and minimum shelf space

Use:

Stochastic optimization

To:

- Optimize the space to give to different groups in a store.
- Object Function would be to maximize the shelf space for product groups (more space for groups with higher effect on sales).
- Constraints would be
 - Min and max space for each product
 - Max shelf space in a store

Problem 4 – Where to locate groups in a store?

Given:

- Groups of products, shelf space amounts and effect on sale (from problem 3)
- Store layout (how many shelves and where in the store)
- High traffic areas in the store. Two ways of capturing this:
 - Foot traffic counters
 - There are electronic sensors that retailers use to count foot traffic. Typically, these are placed at the doors to count people coming in and out. These counters could be placed in different parts of the store to find out areas with high traffic and thus, more potential for sale.
 - Heat maps assessment
 - Retailer could place heat sensors across the store and assess the heat density in different parts of the store over time. This would indicate the areas where there is typically high density.
 - The traffic areas combined with what those areas are typically designated for would tell the retailer, what types of groups would be better suited to place there.
 - Each cluster in the store layout could be assigned a sales effect factor based on the amount of sales of products in that cluster. E.g.
 - If dairy area is a high traffic cluster. It could have an effect factor based on proportion of total sales from dairy sales.

Use:

Stochastic optimization

To:

- Optimize the location of groups in the store (high sales effect groups in high traffic areas for that type of product).
- Objective function would maximize the sales for a group by testing out different locations of the group in the store.
- Constraints would be total shelf space in the store and there could also be constraint on how many groups to put in a given area of the store to avoid overcrowding.