MS-E2177 - Seminar on Case Studies in Operations Research

Optimizing Marketing Promotions for Grocery Retail

INTERIM REPORT

Aino-Nina Saarikoski, Project Manager
Matias Tiainen
Markus Wilkman

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1) Changes in Objectives

During the first phase of our project - as per our project plan (27th of February), we divided out tasks into two major parts:
Part 1: Output 16 promotions at a time and find 64 ‘attractive’ products. With these 4 products, we would target 4 segments, as a one-to-one mapping, i.e. each product targets a single customer segment. Part 2: Decide the discount percentage for each product. By combining part (1) and part (2), we would then obtain the desired algorithm.

The project objectives have now evolved: it has been decided with Kesko to put all our effort into the optimization problem whilst leaving part 2 -finding out the optimal discount percentages (intervals/elasticities) for each product (family)- out of the scope of the project.

At present, our most important task is thus to find the optimal 4-product combinations for 16-week periods so that each week is quite even with the objective function’s result.

2) Project Status & Updated Schedule

The research problematization and the exploratory data analysis are now completed. The former dealt with scoping the project and understanding what Kesko wished and then required, while the latter dealt with understanding and getting familiar with the data in conjunction to plotting inspiring occurrences.

The preprocessing stage is almost finished. We recently discovered some discrepancy with one variable in the data, which we will discuss with Kesko. The preprocessing mostly consisted of identifying outliers in the data, handling them and making sure that the data is unbiased (e.g. campaigns are comparable, taking seasonality into account).

We are simultaneously performing the modelling, optimization and prototyping stages in order to choose the 64 products. More specifically we have identified different measures of goodness for the products (e.g. increase in profit, increase in customers) and constructed a basic optimization model with constraints that make the solution feasible (output 16 products for the 4 groups). Nonetheless, we still need to decide how to solve this multi-objective optimization problem (for example, which measures of goodness should be neglected, could function as constraints or could be added to the objective function).

Possible options for solving the optimization problem are:

-eliciting weights to combine the multiple objectives into one.
-solving for Pareto optimal solutions (solutions where we cannot improve one objective without loosing in another).
-finding non-dominated products (dominated products are solutions which never appear in the optimal solution regardless of weights).

Furthermore, we are currently on schedule and progressing quite efficiently towards our goal.

January & February	**(1) Research Problematization** ecting Research question/scoping. (b) Success Criteria. **(2) Exploratory Data analysis** (a) Outliers' identification & analysis. (b) Examination of key explanatory values and creation of plots for insight into the data. **(3) Preprocessing of data** (a) Define how to aggregate the data. (b) Normalization of the data (relative vs absolute values) (c) Decision on the appropriate attributes (e.g. hierarchy level: product/product family level, profits, incremental sales, sales quantities) (d) Filtering out the unnecessary data (consider only 3-4 day campaigns; leave out the holidays, etc.)
March	(1) **Modelling** (a) Find N distinct sets of 4 unique products so that each set includes at least 1 product with attraction rate (AR) > sigma for each 4 customer segments mentioned in objectives. (b) Identify products that attract different segments using bivariate correspondence analysis (form an attraction rate matrix using overall sales as an underlying measure). (c) Establish a profit structure.

April	**Modelling + Optimization + Prototyping** **(a) Devising solutions for optimization problem** -eliciting weights to combine the multiple objectives into one. -solving for Pareto optimal solutions (solutions where we cannot improve one objective without loosing in another). -finding non-dominated products (dominated products are solutions which never appear in the optimal solution regardless of weights). -Product scoring system. (b) Documentation for source code (c)Literature review **Validation** (a) Discussion with Kesko's experts. (b) Check for similar entries in the data and then look at the outcome.
12th of April	**Interim Report**
End of April & May	**Model Verification** (a) Ask "experts" (Kesko): whether e.g. most attractive products and discount % look reasonable. (b) Within the group, strive for a critical assessment of each of the team members' work.
17th of May	**Final Presentation - Final Report**

3) Next Steps

We will consider closely the most desired products by using Pareto's optimal surface with certain specific interval (e.g. 0.6 to 0.99 weight on Attraction Rate and 0.01 to 0.4 weight on normalized Sales.)

As an example: it is possible to imagine a coordinate, with *weight on AR* corresponds to the *x-axis* and *weight on sales Sales* (or other value) as *y-axis*. According to this configuration, we will gather information about the robustness rates of the products being promoted within these weight-intervals. A 100% robustness rate would imply that a certain product is included in every Pareto optimal solution and should be included in the final solution.

In addition, we tentatively discussed the proposal to score products based on their placements in certain dataframes (Sales, Profits, etc.). After scoring the products based on some yet unknown method/function (perhaps, as potential examples we would look at : w score placements in F1 and or in biathlon). In each of these 6 scenarios, we would combine those placement-scores. We would then sort out the scores from highest to lowest and pick the 16 products with the highest score in each customer group to be promoted.

Furthermore, we will put an emphasis on detailing the documentation for our source code in order to make it easier for others to use and possibly integrate future features on top of it. This was not previously mentioned in our project plan as it was discussed with Kesko's experts on the 10th of April 2019.

We will also start the literature review (which will be synthetized in view of the final report). The current theoretical learnings and their application originate from courses taken concurrently at the Department of Mathematics & Systems Analysis.

4) Updated Risk Management Plan

RISKS	PROBABILITY	EFFECT	IMPACT	MITIGATION STRATEGY
Sub-optimal or inadequate optimization model	(Grey) Very Low	No functional end product	High	-Research. -Test prototype -Feedback -Iterate -Validate the model
Model too complex for the scope of the course	(yellow) low	Too wide & demanding problem to solve for the allocated time.	High	-Scoping & reformulation of the problem to solve. -Adequate deliverables -Establish success criteria.
End product/solution does not satisfy the client.	(Grey) Very Low	Product does not fulfill the expected requirements.	Medium	-Obtain regular feedback from and cooperation with Kesko- -Iteration /test

DATA: **data gathering/filtering**	(Yellow) Low	Data noise Data bias	Low impact on the model	-Data analysis -Regular Brainstorming with Kesko -Exploratory data analysis - Code reviews
Insufficient communication between team members	(Light Orange) medium	-Imbalance in workload between team members -Misunderstanding due to different disciplinary background	Medium	-Weekly team meeting -Regular communication between team members -Scheduling
Team members other commitments	(Light Orange) low to medium	-Having to postpone to the last minute some tasks before a deadline	Low	-Planning/Scheduling - Weekly team meeting -Regular communication between team members