

Master Thesis Proposal

Do sales volume leaders have a market advantage? Estimation and optimization of a product portfolio considering network effect

Consumer purchase decision are dependent on different aspects of a product. First, there are functional attributes like color, size or price that are directly influenceable by the firm's decision maker. On the other hand, experiential and social attributes like reputation, recommendations or network effects are much more difficult to influence. The network effect describes a behavior, where people value an item dependent on the products sales. A market leader, who had a high sales volume in the past can have a competitive edge as consumers tend to choose this company preferably.

In general, companies can benefit from the network effect to optimize sales by accounting for endogenous network effects in their forecasts. Predictive choice models, like the multinomial choice model (MNL), are often used to describe customer purchase behavior. An underlying assumption of the models is the possible decomposition of the product or service in attributes with different levels, where each attribute level is connected to a particular partial utility. The conjoint method is a survey like analyses, which can estimate model parameter. Wang (2020) showed that it can be beneficial to sell a product below its marginal costs, in order to stimulate other sales of more profitable products. Wang and Wang (2017) consider the assortment planning problem under an MNL choice model with endogenized network externality. Furthermore, the authors propose a method for estimating an endogenized MNL model based on both uncensored and censored data and applied it to the games store.

A holistic overview over potential objectives is to:

- review the basic empirical and optimization-related literature on discrete choice models under consideration of network effects,
- to identify and discuss the state-of-the-art approach for estimating choice models with endogenous network effects from panel data or with a conjoint analysis,
- to estimate the network effect from panel data or with a survey (conjoint analysis) for a product of your choice, or alternatively,
- to implement a MNL based optimization model in AMPL, compare the impact on revenue if network effect is neglected and answer if sales volume leaders have a market advantage,
- to comment, if companies should incorporate network effects in their decision-making process and what difficulties they may face from an estimation and optimization point of view,
- and to provide open research gaps and future trends.

The student can choose the focus of his work:

- Either focus on empirical analyses and an optional implementation of an optimization model,
- or use available empirical data from literature and focus on the implementation of the optimization model.

Recommended basic literature:

Birke, D. (2009). THE ECONOMICS OF NETWORKS: A SURVEY OF THE EMPIRICAL LITERATURE. *Journal of Economic Surveys*, 23(4), 762–793. <https://doi.org/10.1111/j.1467-6419.2009.00578.x>

Wang, R., & Wang, Z. (2017). Consumer Choice Models with Endogenous Network Effects. *Management Science*, 63(11), 3944–3960. <https://doi.org/10.1287/mnsc.2016.2520>

Wang, R. (2020). On the assortment optimization with endogenized market size. *Operations Research Letters*, 48(5), 682–686. <https://doi.org/10.1016/j.orl.2020.07.011>

Du, C., Cooper, W. L., & Wang, Z. (2016). Optimal Pricing for a Multinomial Logit Choice Model with Network Effects. *Operations Research*, 64(2), 441–455. <https://doi.org/10.1287/opre.2016.1487>