Optimizing Assortment Size in Online Platforms

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Motivation and Overview

Giving customers more choices is usually believed to aid sales, by satisfying customers with diverse preferences. Recently, in psychology, marketing and behavioral economics literature, it has been observed that more choices can end up reducing sales.
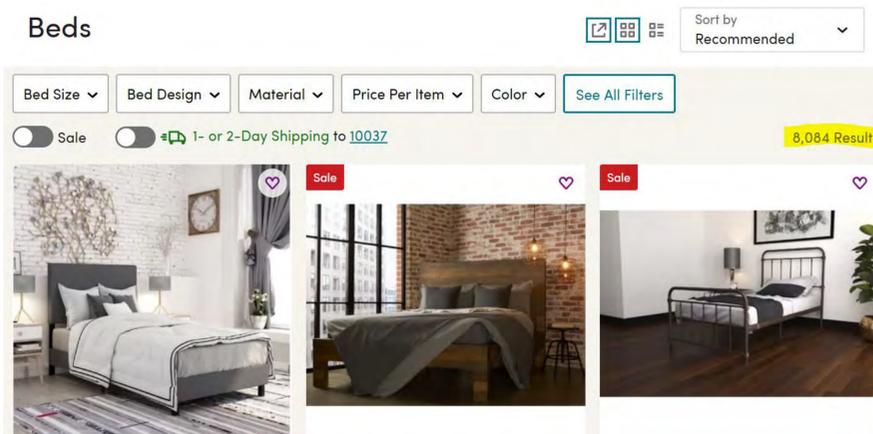

Figure 1. Screenshot from wayfair.com (an online home goods seller) for search query "bed"

We develop systematic structural estimation approach for estimating a choice model with this **choice overload effect**. Since standard models don't account for this, we introduce a behavioral modification. Our main goal is to determine the **optimal size of assortment for an online platform**.

Data

Wayfair is an online retailer of home goods. We use transaction and browsing data from allmodern.com – a curated website owned by Wayfair, Inc – from March 2018. We see 18k products sell from 350 *classes* (e.g. beds is a class, tables is another). For each product we observe: • price • wholesale cost • review score • search rank. We see a total of 1.5m customers browsing, and those that buy place 80k orders.
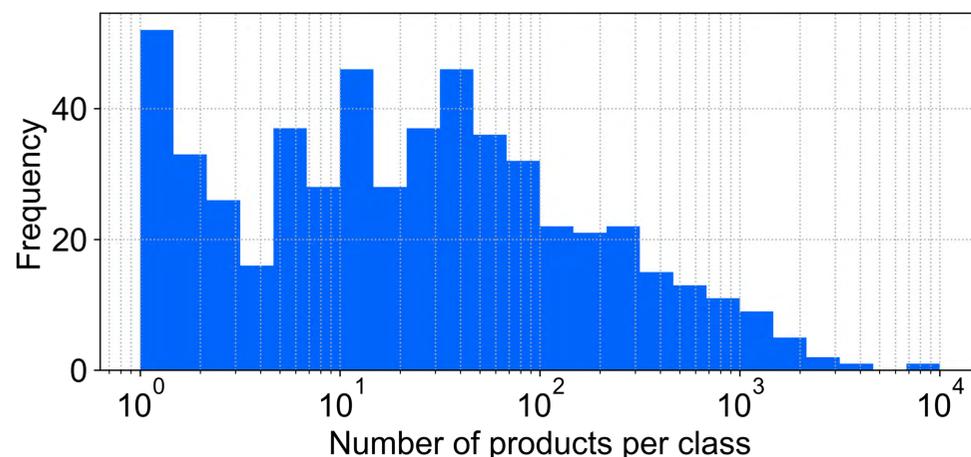

Figure 2. Distribution of number of products on allmodern.com by "class"

Methodology

Our overall strategy follows the **Hausman-Taylor approach**. First, we estimate a discrete choice model (MNL), where in addition to estimating coefficients for product-level characteristics, we estimate a **class-level categorical coefficient**. Second, we explain this class-level effect as a log-quadratic function of the class assortment size.

Endogeneity: Price and assortment size are determined in a way that is correlated with unobserved factors affecting demand. We include cost in our MNL model to deal with price endogeneity. We use assortment size on parent website wayfair.com as an **instrument**, for assortment size.

Counterfactual: dropping 10% products at random

Firstly, we see a significantly positive instrument coefficient, & significantly negative number of products coefficient (for class-level effect). Second, we measure the effect in probability of purchase.
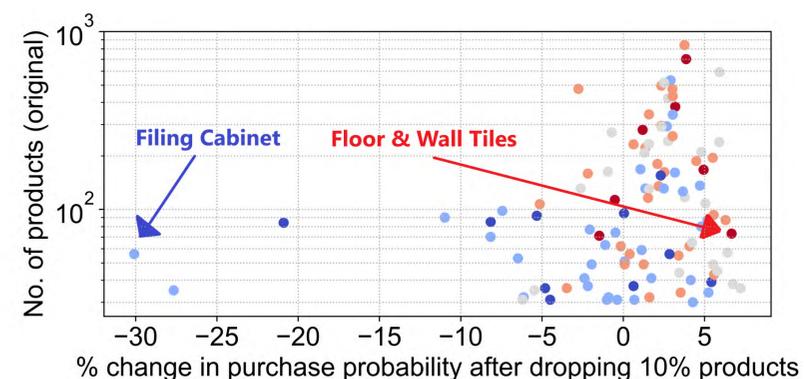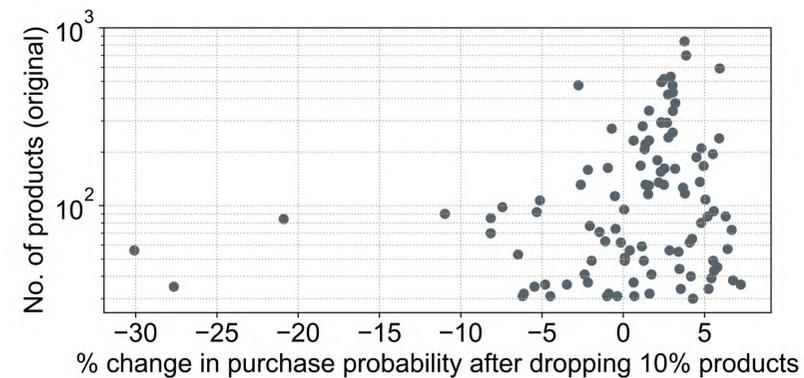
Currently too many products for majority of classes: more so for **aesthetic** classes than **functional**.

References

[1] *When choice is demotivating: Can one desire too much of a good thing? (2000).* Iyengar and Lepper.

[2] *Unobserved product differentiation in discrete choice models: Estimating price elasticities and welfare effects (2002).* Ackerberg and Rysman.