Optimizing Targeting Strategy for Services

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IMPACT

Capability to personalize service offerings, improving customer experience & leading to multi-million dollar uplift

Scalable, holistic framework that can be expanded to additional services and tools, as well as to new customer touchpoints

Methodology to inform business decisions, enabling better customer targeting and identification of areas of opportunity for services

CENTRAL QUESTION

For each Wayfair customer session, which service(s) should be presented at which point of the online shopping experience to maximize the net present value (NPV) of engagement?

CONTEXT

- In addition to offering "A Zillion Things Home," Wayfair offers a range of **services** aimed at alleviating stresses of the home-shopping experience.
- There is an underlying belief that these services provide **positive experiences** and **increased customer loyalty**. This increase in loyalty generates additional value for Wayfair through **incremental long-term revenue**.
- Currently, service impressions are not personalized. Presenting irrelevant services leads to increased **cognitive burden** on the customer and increased **page load times**, harming the customer experience and possibly leading to lower **conversion rates**.
- **Curating the services Wayfair exposes to its customers** is important, and this curation should be informed by accurately modeling customers' **estimated incrementality** and **likelihood of signing up** for services.

GOALS

1. To develop an analytical approach for estimating service NPV and sign up propensity, at an individual level, to determine which services to display at different points in the session experience
2. To inform business decision making based on insights obtained from interpretable models

KEY DEFINITIONS

- **Net Present Value (NPV):** Immediate Revenue Generated + Incrementality – Service Fulfillment Cost
- **Incrementality:** Additional revenue generated due to a positive experience with a Wayfair service
- **Service Impression Action:** An action on the part of Wayfair to show a service, or combination of services, to a customer on a particular website page

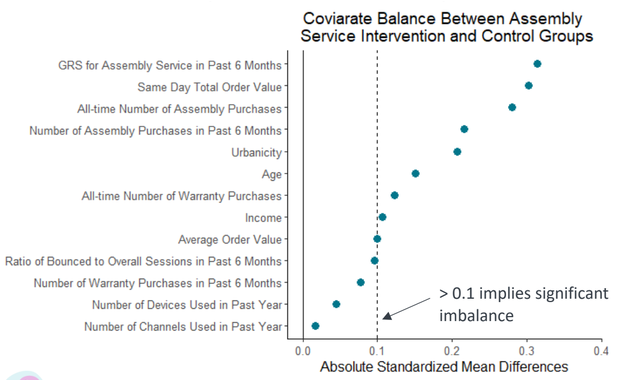
DATASETS

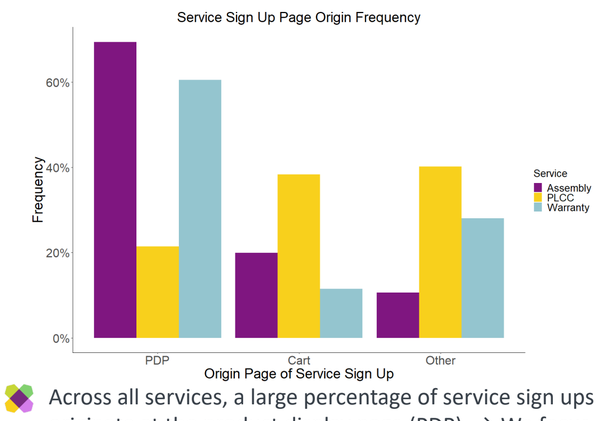
Scope: B2C Customers | 3 Services | 3 Modeling Components | > 1M Customer Sessions | > 100 Features

- **Past Website Interactions:** Devices & Platforms Used, Marketing Acquisition Channels
- **Past Purchase Behavior:** Price Sensitivity, Average Order Value, Number of Past Orders, Gross Revenue Stable at Specified Time Periods
- **Engagement Metrics:** Frequency of Website Visits, Ratio of Bounced Sessions to All Sessions, Idea Board Usage, Internal Search Usage, Average Session Duration
- **Static Session-Level Features:** Marketing Channel Leading to Session, Marketing Visitor Type, Days Since Last Visit, Days Since Last Order
- **Dynamic Session-Level Features:** Current SKU Display Price, Current SKU Service Prices, Number of PDPs Visited, Running Add-to-Cart & Remove-from-Cart Counts

EXPLORATORY INSIGHTS

Pre-intervention attributes differ between customers in the intervention group vs. the control group. → Our NPV models must account for potential bias induced by these differences.





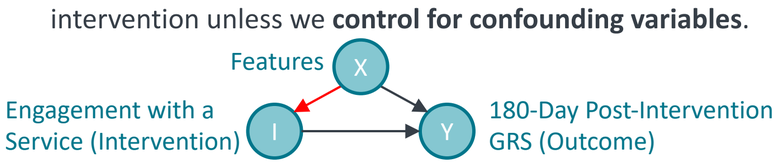
Across all services, a large percentage of service sign ups originate at the product display page (PDP). → We focus our propensity modeling on the PDP and, consequently, develop service impression recommendations at each PDP viewed during a session.

NPV ESTIMATION

Key Question: *How much more* will a customer spend in the future *as a result of engaging with a service* (the intervention), relative to what they would have spent otherwise?

Key Modeling Considerations

1. This is a causal question. For each customer, we observe (1) what happened if they signed up **or** (2) what happened if they did not, but **never both**. We have no ground truth.
2. Features (X) might be related to the intervention (I) and the outcome (Y). We will not be able to learn the effect of the intervention unless we **control for confounding variables**.

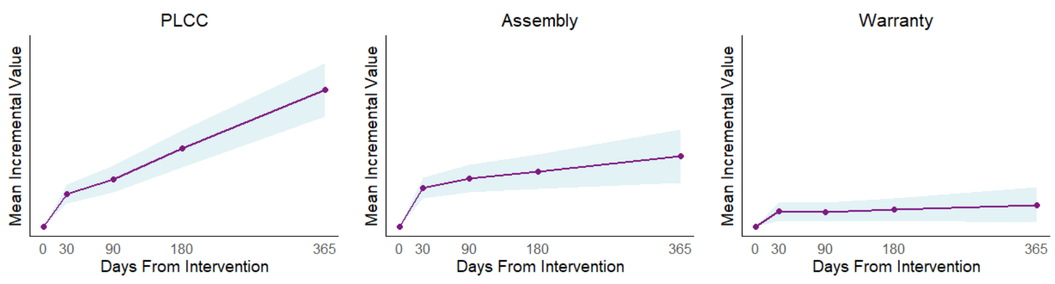


MODELING

Approach: Utilizing **Double Machine Learning** and **Causal Forests** allows us to:

- Estimate incremental value at the **individual** customer level
- Control for a **high-dimensional** set of potential **confounders**
- Identify **differentiated incremental values** across different customer segments
- Quantify our uncertainty via **confidence intervals** and perform statistical significance tests

For each service, we create models for different time points in the future to estimate the trajectory of incremental value.*



- **Highest average incremental value**
- **Linear** trend for over time

- **Asymptotic** trend
- Comparison to PLCC suggests differences in **long vs. short-term engagement** services

- **Hypothesis:** Case-specific nature of engagement with Warranty leads to fewer touchpoint opportunities

** Note: Y-axis values removed for confidentiality purposes.*

SIGN UP PROPENSITY

Key Question: At each product display page (PDP), *which service* is a given customer *most likely* to sign up for?

Key Modeling Considerations

1. Sign ups depend on customer needs and preferences, which are revealed through their **historical** and **current interactions** with the Wayfair website.
2. Wayfair wants to understand which customer features contribute to differences in response behavior, so **interpretability matters**.

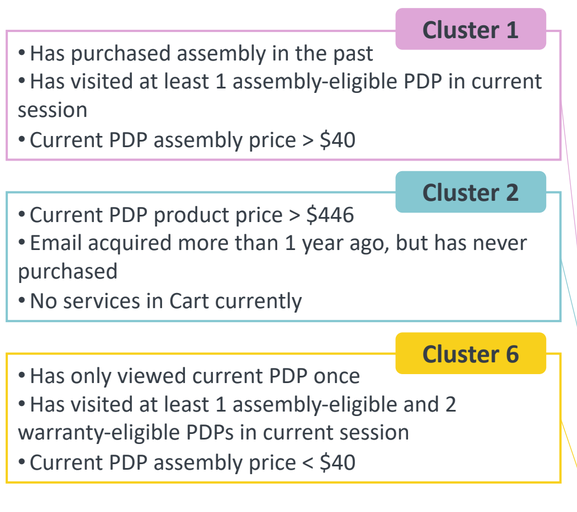
MODELING

Approach: We develop a novel algorithm, **Cluster-While-Classify (CWC)**, to find customer segments such that customers are **similar within** each segment but **differ across** segments in **how they respond** to Wayfair service impression actions.

CWC Procedure:

1. Initialize clusters
2. Model response to Wayfair service impression actions using regularized multinomial logistic regression for each cluster
3. Iteratively update cluster assignment based on logistic loss
4. After obtaining final assignments, fit a decision tree to classify observations into clusters and use the fitted tree to classify new observations

Results: 0.71 Macro Avg F1-Score (Using Only 7 Features)



*At the current PDP, if Wayfair shows service impressions for PLCC, Assembly, & Warranty, we obtain an **ordering of responses** from **most likely** to **least likely** for each cluster:*

	Most Likely Response → Least Likely Response			
1	Assembly	Warranty	No Service	PLCC
2	PLCC	Assembly	Warranty	No Service
⋮	⋮	⋮	⋮	⋮
6	No Service	Assembly	PLCC	Warranty

OPTIMAL SERVICE PRESENTATION

Key Question: How can we make use of our NPV estimates and service sign up propensities to *personalize service impressions* to customers?

Key Modeling Considerations

1. Formulate as an optimization problem that can be **solved efficiently**
2. Strike the right balance between **reducing customer cognitive load** and **maximizing revenue**
3. **Quantify expected business impact** on key metrics through simulation and **sensitivity analysis** under different assumptions

Objective: Maximize Expected Value of Sign Up – Cost of Display
Decision: Which Service Impression Action to Display

Opportunities to personalize services for over **60%** of customer sessions

Approximate expected uplift of **$80-100M** in annual revenue (1)

(1) Hypothetical estimates were obtained by MIT Capstone students using financial and web traffic data for FY2019

CONCLUSIONS & NEXT STEPS

Conclusions:

- We have created an end-to-end analytical framework for personalizing service messaging for Wayfair, which can also be applied generally in a wide range of retail settings.
- Our methodologies can be adapted to answer questions of a similar nature across Wayfair's other business functions.

Next Steps:

- Stress-test and improve our models based on stakeholder and service owner feedback
- Expand scope of modeling to more services and additional session touchpoints
- Perform A/B testing to validate our estimates about the impact of our framework on revenue