Optimizing Targeting Strategy for Services

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**CONTEXT**
In addition to offering “A Billion Things Home,” Wayfair offers a range of services aimed at alleviating stressors 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, HURTING THE CUSTOMER EXPERIENCE AND POSSIBLY LEADING TO LOWER CONVERSION RATES. CURATING THE SERVICES WAYFAIR EXPOSES TO ITS CUSTOMERS IS IMPORTANT, AND THIS QUESTION SHOULD BE INFORMED BY ACCURATELY MODELING CUSTOMERS’ ESTIMATED INCREDIBILITY AND LIKELIHOOD OF SIGNING UP 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?

**GOALS**
1. To develop an analytical approach for estimating service NPVs 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**

<table>
<thead>
<tr>
<th>DATASETS</th>
<th>Scope/KYC Customers</th>
<th>Services</th>
<th>Model Components</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Past Website Interactions: Devices &amp; Platforms Used, Marketing Acquisition Channels</td>
<td>3 Services</td>
<td>3 Modeling Components</td>
<td>&gt; 100 Customer Sessions</td>
<td></td>
</tr>
<tr>
<td>Past Purchase Behavior: Price Sensitivity, Average Order Value, Number of Past Orders, Gross Revenue Stable at Specified Time Periods</td>
<td>&gt; 100 Customer Sessions</td>
<td></td>
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<tr>
<td>Engagement Metrics: Frequency of Website Visits, Ratio of Bounced Sessions to All Sessions, Idea Board Usage, Internal Search Usage, Average Session Duration</td>
<td>&gt; 100 Customer Sessions</td>
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**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**
- 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.
- 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.

**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

**EXPLORATORY INSIGHTS**

**SIGN UP PROPENSITY**

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

**Key Modeling Considerations**
- Sign-up depends on customer needs and preferences, which are revealed through their historical and current interactions with the Wayfair website.
- Wayfair wants to understand which customer features contribute to differences in response behavior, so interpretability matters.

**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)

**MODELING**

- **Cluster 1**
  - Has purchased assembly in the past
  - Has visited at least 1 assembly eligible PDP in current session
  - Current PDP assembly price > $40
  - Has made purchase more than 1 year ago, but has never purchased
  - No services in cart currently

- **Cluster 2**
  - Has only viewed current PDP once
  - Has visited at least 1 assembly eligible and 2 warranty-eligible PDPs in current session
  - Current PDP assembly price > $40

**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**

**OPTIMAL SERVICE PRESENTATION**

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

**Key Modeling Considerations**
- Formulate as an optimization problem that can be solved efficiently
- Strike the right balance between reducing customer cognitive load and maximizing revenue
- 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**: $80–100M in annual revenue

**APPROXIMATE EXPECTED UPLIFT OF**

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