# Demand Xplainer

## Finding Xfinity's Optimal Olympics Offer

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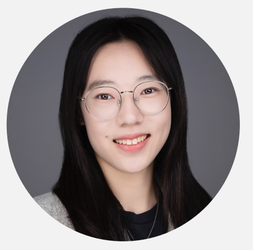

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## Problem Statement

What is the **impact of price and marketing spend[1] on demand**, measured by new connects to Xfinity internet service?

In other words, what are the **price and advertising elasticities of demand**?

## Data and Scope

| Connects | Prices | Marketing | 105 DMAs | 2022-2023 |
|---|---|---|---|---|
| Daily record of residential Comcast customers | Xfinity pricing and offer availability for different plans | Display, paid search, radio, TV, print media spend | 13 regions<br>105 Designated Marketing Areas | 2 years<br>9M customers<br>11M transactions |

## Methodology

### Model

**Features**

Key Features
Price
Marketing spend
Price of other speed tiers

Controls
DMA
Internet speed tier
Plan type indicator
Month
Marketing share of voice

**CatBoost** → **Target**: Log number of connects

LightGBM
XGBoost
Random Forest
Linear Regression

**How does the model estimate elasticities of demand?**
We calculated 1-dimensional partial dependence values which estimate own-price, advertising and cross-price elasticities of demand. We also calculated 2-dimensional partial dependence values which estimate joint elasticities of demand.

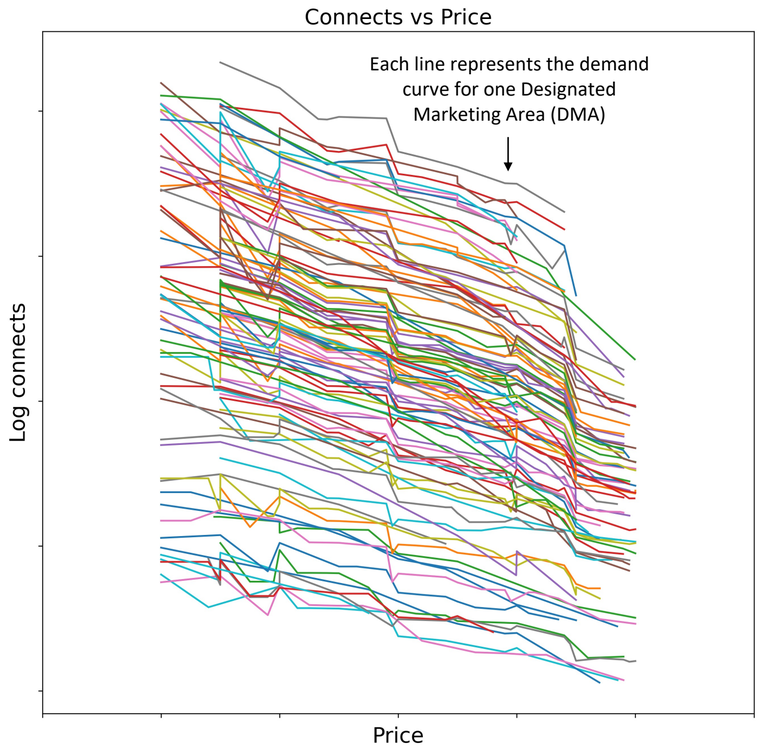
**What are partial dependence values and how are they obtained?**
Partial dependence values show the marginal effect of the feature on the model's prediction while averaging out the effects of all other features in the data. For a given price, the partial dependence value (i.e., expected number of connects) for a particular DMA is the average of all predictions of the model at that given price, while other features are set to their respective values in the DMA-filtered data. This also allows us to calculate joint partial dependence values of price and marketing spend, by changing both at the same time.

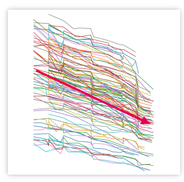
**Why can't SHAP values be used?**
SHAP values show feature importance and quantify the contribution of each feature to the specific prediction of an instance. However, they are not the same as coefficients and do not show how expected connects changes along a range of prices and marketing spends.

**Why CatBoost?**
CatBoost offers significantly faster training speed due to efficient handling of categorical features, while maintaining similar MSE to other tree-based models.

### Partial Dependence Plots

**Price elasticity of demand**



**General Trend**
As price increases, the number of connects decreases. This negative relationship is consistently observed across DMAs.

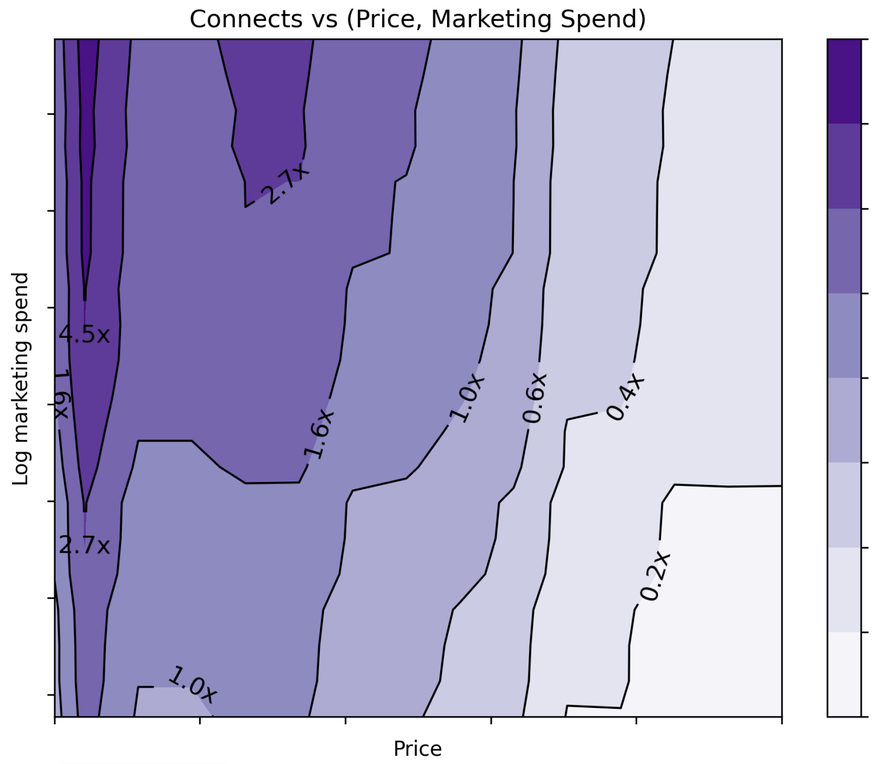
**Trend for Individual DMAs**
Significant heterogeneity of price elasticities is observed across DMAs. Price elasticities are not directly correlated with DMA size.

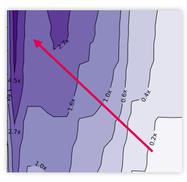
**Advertising elasticity of demand**


**General Trend**
As marketing spend increases, the number of connects increases. This positive relationship is consistently observed across DMAs.

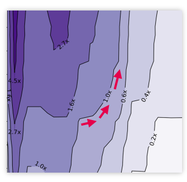
**Trend for Individual DMAs**
Significant heterogeneity of advertising elasticities is observed across DMAs. Connects are less sensitive to advertising than price.

**Joint elasticities of demand**



**General Trend**
As price decreases and marketing spend increases, the number of connects increases. Effects differ for different levels of price and marketing spend.



**Trend for Indifference Curves / Contour Lines**
As price increases, higher marketing spend is needed to maintain the same number of connects. There exists diminishing returns for marketing spend.

## Results and Impact

# +4.9%

Profit[2] over baseline under Olympics offer

When jointly optimizing for price and marketing spend

**Optimizing for price alone**

Demand Xplainer identifies $A+ as the optimal price, estimating an overall increase in revenue by 1.4% relative to lower price $A. It measures changes in revenue from entry-speed connects using own-price elasticities, and changes in revenue from medium-speed and fast-speed connects using cross-price elasticities.

| Change in … | Going from $A to $A+ |
|---|---|
| Number of entry-speed connects | −11.8% |
| Price for entry-speed connects | +16.7% |
| Revenue from entry-speed connects | +2.9% |
| Revenue from medium and fast-speed connects | +0.8% |
| Revenue | +1.4% |

**Jointly optimizing for price and marketing spend**

Demand Xplainer identifies ($A+, +10%) as the optimal combination of price and marketing spend, estimating an overall increase in profit by 4.9% relative to baseline. It measures changes in revenue using joint elasticities and changes in cost using marketing spend to calculate changes in profit.
Results highlight the benefits of co-ordination across pricing and marketing teams.

| Optimized price? | Optimized marketing? | Optimized jointly? | Solution | Increase in profit relative to baseline |
|---|---|---|---|---|
| ✗ | ✗ | ✗ | ($A, +30%) | - |
| ✗ | ✓ | ✗ | ($A, **+5%**) | +0.7% |
| ✓ | ✗ | ✗ | (**$A+**, +30%) | +4.5% |
| ✓ | ✓ | ✗ | (**$A+**, **+5%**) | +4.8% |
| ✓ | ✓ | ✓ | (**$A+**, **+10%**) | **+4.9%** |

**Disclaimers:** [1] Marketing spend shown is the median value across different Designated Market Areas and does not represent actual marketing spend.
[2] Profit represents the profit from this specific initiative only and does not reflect overall company profit.