Learning about Demand: An Empirical Investigation of Dynamic Pricing in the Airline Industry

Faculty Member: Kevin Williams
This project is eligible for remote work.

Proposal Description:

Many markets are characterized by fixed and perishable capacity, a gradual arrival of consumers, and uncertainty concerning the overall magnitude of demand. Some examples include air travel, hotels, trains, and entertainment or sports events. In order to manage these situations, many firms undertake dynamic pricing, often called “revenue management” by industry practitioners. Prices may adjust based on changes in the elasticity of demand or changes in the opportunity cost of remaining capacity. The latter may occur due to stochastic demand, but also because firms may acquire information over time. For example, a flight may be a peak demand flight and this is not initially known. Empirical studies of dynamic pricing with demand learning are limited, however, due to the difficulty in modeling the complex dynamic problem facing firms and the unavailability of detailed data on prices, quantities, and firm beliefs. This project conducts an empirical investigation of revenue management (RM) and quantifies the welfare impacts of dynamic pricing with demand learning in the airline industry.
Our work leverages novel data provided by a large international airline based in the United States. On the demand side, we observe how consumers search for flights and capture all relevant booking information. On the supply side, we observe rich information from the air carrier’s inventory revenue management software, including forecasts, pricing decisions, and even adjustments made manually by revenue managers. The data provide unique opportunities to investigate an industry that accounts for over $1.6 trillion in US economic activity every year.
In our first project, we investigate the ability to learn about demand over time and quantify the consequences of demand learning on welfare. For example, if a firm incorrectly believes that an off-peak flight is peak, prices will be too high and output inefficiently low. On the other hand, demand learning may allow a firm the ability reserve capacity for those with the highest willingness to pay and extract their surplus through targeted prices. We propose a new methodology to estimate demand in markets with sparse sales and endogenous prices by combining features of stochastic demand models in operations research with random coefficients demand models that are commonly used in industrial organization and quantitative marketing. Although we tailor our specifications to the airline industry, our modeling approach can be applied to any setting where researchers have access to search and sales information. E-commerce is a relevant application. With demand estimates, we compare how the firm allocates capacity in practice to the outcomes of a Bayesian learning model in which the firm updates its beliefs about future demands by observing consumer arrivals. We contrast these findings to a model in which the firm does not update its beliefs over time.

Requisite Skills and Qualifications:
I am looking for an RA to help with data wrangling and conducting exploratory data analysis. This involves downloading information from the internet, parsing unstructured files, and working with large data sets. The RA should have experience with Python.

Award: Daniel Lu
Tobin Application Link: Tobin Application
Project Type: Tobin RA
Project Year: 2020
Term: Fall 2020

Source URL: https://economics.yale.edu/undergraduate/tobin-ra/fall-2020/learning-about-demand-empirical-investigation-dynamic-pricing