# How AI Learns What You’re Willing to Pay and Why We’re Paying Different Prices

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Why are we all paying different prices? Is it ‘price personalization’ or a form of 'price discrimination'? The answer isn't so simple.

The world of AI dynamic pricing engines is rapidly progressing and changing the competitive landscape. This article provides a high-level overview of a few evolving areas that influence how an AI pricing engine decides the price to show you:

1. Learning competitive response
2. Predicting market demand & micro-segmentation
3. Accumulating asymmetric information
4. Estimating ‘Willingness to Pay’
5. Shaping demand dynamically

## 1. Learning Competitive Response

Like chess, understanding how your opponent plays the game is important to playing the game strategically to win. Ideally, if you understand the rules, logic and strategy of your opponent, you can use this information to design a winning strategy that takes advantage of the predictability of your opponent’s moves.

An AI pricing engine can similarly try to learn the competitors’ pricing rules, logic and strategy by observing “competitive pricing response”. By jiggling many prices up and down an AI pricing engine observes if and to what magnitude the competitors adjust their price. Since many companies are still making pricing decisions based on legacy business rules, decisions trees, regression models and other types of equations, it is possible for a sophisticated AI to ‘learn’ complex non-linear representations of these legacy pricing algorithms. Much like in chess, once a competitor’s rules and logic are understood, their competitive pricing response becomes more predictable. The AI ‘black box’ approximations of competitive response can be used to discover optimal strategic pricing moves and predict likely next moves by a competitor for a given pricing change. To liken this back to chess, if you know how your opponent will respond to your moves, you can ‘lead’ them around the board to win the game consistently.

The pricing game is much more complex than chess with the competitive response modeling being just one of many strategic levers. The price jiggling above also provides data about the price elasticity of demand, which brings us to the next part of the story.

## ****2. Predicting Market Demand and Micro-Segmentation****

Imagine you are a widget store owner with 50 widgets in your inventory, and you need to sell all 50 of your widgets by the end of the week. Customers stream into your store, inquire about price and then decide to buy or not buy. A big factor for you as the shop owner is knowing how many more customers will come into the store that week. If you believe only 75 customers will come by you would price and negotiate very differently than if you thought 5,000 customers would stop by. It starts to get more complex with perishable widgets, like hotel rooms, airline flights, concert tickets, etc… because the value of a widget becomes $0 at the end of the week. For example, it is not possible to sell a seat on a plane after the flight has departed.

Micro-segmentation uses many different attributes and behaviors to bucket customers by estimated willingness to pay. To keep things simple, let’s assume we have three buckets: (A) high paying, (B) medium paying and (C) low paying. An overly simplistic model to maximize profits would be to capture all the sales from the high paying group #A and then backfilling with medium paying group #B. Any leftovers could then get sold to low paying group #C .

Wait a second! We all know airline prices go up as the booking date gets closer to the departure date. Everyone knows to get a great price on an airline ticket you should book early. So, it’s not as easy as first selling to high paying group #A, then medium paying group #B and giving leftovers to low paying group #C. In most cases the pricing and selling happens in the reverse order – Low paying group #C, then medium group #B and lastly high paying group #A. This means that estimating predicted demand by bucket and willingness to pay of groups #A, #B and #C is critical to maximize profit and prevent over or underselling to any group.

## 3. Accumulating Asymmetric Information

A big part of the AI or algorithmic pricing game is having AI that can learn everything about what is happening in the market to have more actionable information than competitors. This information advantage can be referred to as asymmetric information. In terms of demand prediction, asymmetric information allows the AI pricing engine to achieve a more accurate demand prediction than competitors. Ultimately, this advantage results in greater confidence by the pricing engine to hold a price or move it up or down to maximize profit in response to what is happening in the market.

To see how this works, let’s take a hypothetical airline market with 3 airlines serving a destination like Porcupi, Montana. In the airline industry, Porcupi is a small town that sits in the ‘long tail’ of total revenue. Just like other industries, the total of all the ‘long tail’ revenue items can add up to be a big revenue number. However, a single item in the ‘long tail’ only contributes a very small amount to the total. For Porcupi, it is in the ‘long tail’ and doesn’t generate enough revenue to justify economically employing a human by the airlines to monitor what’s happening in the small city.

Now suppose you are an airline operator and you happen to know a big festival will soon take place in Porcupi because a relative happens to live there. You know that significantly more people will be going to Porcupi than the number of available airplane seats across all the competitors. If you are the only airline operator who knows about the big festival, then the pricing strategy is easy. Hold the price high until all the competitors have sold all their seats. Then, travelers will have to pay a very high price for a seat on the last plane into Porcupi.

This example is a bit contrived because in many ‘long tail’ markets it doesn’t economically make sense for a human to monitor at an item level and make micro-adjustments to prices. This is where AI + Big Data comes into the picture. AI can learn about local events that are happening in real time on a global basis far more economically than what could ever be achieved by a host of humans. This enables asymmetric information which allows better demand predictions and strategic pricing responses.

## ****4. Estimating Willingness To Pay****

Determining willingness to pay reminds me of when I was a tourist in Beijing, China. We booked a tour bus and one of the stops was a ‘tourist trap’ shopping market. There were no prices on anything in the market and the prices were set dynamically through negotiations with the vendor. When the tour group got back on the bus, we discovered we all paid wildly different prices for similar items. My friend and I had each purchased nearly identical shirts. He paid 275 ¥ and I paid 40 ¥. I still don’t know if I got a ‘good deal’ on my shirt or not, but I do know the vendors did an excellent job of determining ‘maximum price’ that each tourist was willing to pay. Most of the vendors didn’t speak English, but by simply observing body language during negotiations and physical appearance the vendors made good estimates of a ‘maximum price’ that each tourist was willing to pay for items.

An AI pricing engine is roughly doing the same thing to estimate your willingness to pay. Data is constantly being collected about your customer behavior such as:

* What type of items did you look at?
* How long did you spend on each web page?
* What items did you put in your basket?
* What items did you purchase?
* What do people pay that look and behave like you?

All this data and more gets fed into an AI engine that translates your behavior into a persona and tries to predict things about you, one of them being estimating the ‘maximum price’ you are willing to pay.

Keep in mind, this doesn't imply you will receive a 'personalized price' even though it is technically possible. The practice of 'personalized pricing' is highly debated for numerous reasons including ethical, brand, loyalty and legal concerns. It is an article in itself.

In other words, 'willingness to pay' can be used to determine how likely you will purchase an item at the current market price. This likelihood gets incorporated into demand predictions by micro-segment and, ultimately, the price. Consequently, the AI engine can control sales velocity by knowing how much to sell at what price. The AI engine determines that, for a given market price, there will be a proportion of the market who purchases and a proportion that doesn't purchase. An astute marketer might use this information as a targeted promotional opportunity if the market price is above the 'maximum price' willing to pay. As a result, people are generally 'OK' with receiving a coupon or a discount, which is technically a form of price discrimination.

## ****5. Shaping Demand Dynamically****

Predicting competitive response + predicting demand + micro-segmentation + ‘maximum price willing to pay’ are all based on probabilities. There will always be some level of ‘error’ in the predictions. In other words, things may sell a little faster or slower than expected. AI pricing engines use dynamic demand shaping to change the shape of the demand curve by adjusting prices. This could be based on real-time inventory or any other myriad of factors. In the airline and hotel pricing world, demand shaping can be used to optimize profit and minimize overselling or underselling airline seats and hotel rooms.

## ****Conclusions****

Every industry is selling a product or service to a customer at some price. The topics discussed in this article are broadly applicable to a wide range of industries and business scenarios outside just dynamic pricing of airline seats and hotel rooms. Manufacturers estimate demand to know which products to produce in what quantities. Distributors manage pricing and demand forecasts to optimize inventory and distribution logistics. Marketers use demand estimations to make decisions of promotions, targeting and marketing spend.  Advanced algorithmic techniques and AI engines like discussed in this article are quietly transforming how organizations compete. The result of all the complex algorithmic interplay is the price we are quoted, the advertisements we are shown and the product mix we find when shopping.

I hope you enjoyed the very high-level tour of some of the factors that go into AI dynamic pricing engines. This article is by no means complete, as it skips over more complex topics like network effects, opportunity costs and other industry specific considerations.

## ****About Me****

My passion is innovation, pushing the boundaries of technology and how it is applied in business. I’m currently engineering machines that can learn to make human-like decisions at massive scale to help large organizations compete in a world that is becoming more algorithmic and a competitive landscape that is heading towards AI vs. AI.