



Book The Future of Pricing

How Airline Ticket Pricing Has Inspired a Revolution

E. Andrew Boyd
Palgrave Macmillan, 2007

Recommendation

Sometimes the most obvious business practices are the most complicated – and the most interesting. This is the case with airline pricing, so E. Andrew Boyd has chosen a great topic. As an expert in the esoteric field of operations research, he has done business readers a great service by presenting the history, evolution, theory and practice of airline pricing, and by tracking how it revolutionized pricing in many other industries. Boyd weaves his personal stories and insights about mathematics, gambling and airline history into a very readable, high-level business book. While this is a seemingly esoteric topic, *BooksInShort* highly recommends his book to those in the transportation, travel, tourism and restaurant businesses. It will be especially valuable to intrepid executives in other industries who want to push the frontiers of pricing based on the latest science about operations.

Take-Aways

- Airline pricing changed after the industry’s deregulation when carriers began charging business and leisure passengers each different fares.
- Airlines use customer behavior and buying preferences to set the bid prices for tickets.
- Airlines rely heavily on forecasting to evaluate their pricing strategies.
- Scientific pricing is based on optimal inventory management.
- An empty seat changes from saleable to worthless when the plane departs.
- Inventory management for the airline means making a seat more saleable instantly by repricing it as circumstances evolve.
- The travel industry – hotels, car rentals and cruise ships – has adopted the airline industry’s “scientific pricing” techniques.
- Disney’s industrial engineers measure the amount of time people sit at restaurant tables (“turn time”), and adjust reservation slots and volume accordingly.
- Companies using “customer-centric” or dynamic pricing charge different rates to different customers, based on each customer’s profile and needs.
- Now that the airline industry has implemented dynamic pricing, other industries are following suit.

Summary

What’s the Price?

Setting prices is not easy. While pricing can determine the success of any company, most managers worry more about pricing their goods than about their actual pricing philosophies and policies. Companies choose prices that factor in their margins over the cost of production or they base their prices on what the competition charges. Pricing to accommodate a commission-based salesforce is a more complicated equation, in that managers must offer competitive prices and keep the sales staff happy.

“With decades of accumulated knowledge, airlines continue to play a central role in developing the science of inventory control and pricing.”

Technology can make the complex job of setting prices more manageable. Airlines have been especially proficient in using computers to set prices amid heavy regulations. For instance, they developed computerized reservation systems that predated the Internet by years. Today airlines “practice the most sophisticated pricing ever conceived” as they continually update ticket prices based on consumer behavior, cancellations and bookings.

“The range of emotions we experience when purchasing an airline ticket is often closer to that of a bidder in an auction than to that of a customer in a retail

store.”

To derive the maximum benefit from your pricing policies, investigate the mathematics of “scientific pricing.” Companies use this calculation tactic to, for example, explore ways to increase a product’s profit potential. For instance, a seller might try to determine if it can double its profitability on an item that costs \$100 to produce, if it can change the price from \$101 to \$102 without dramatically cutting consumer demand. Today’s proliferation of customer data has sparked a revolution. Industries as diverse as energy, chemicals, cargo, financial services, retail, pharmaceuticals, advertising and health care are all using this data to update pricing procedures.

Scientific Pricing

Scientific pricing takes all aspects of your business into account. Typically, any pricing process examines the performance of individual retail locations, the demands of different customers, and the historic relationship between price and demand. While acknowledging the role of randomness, companies use this data in forecasting, managing expectations and developing consistent, profitable pricing strategies. Any price has to cover production, cost-to-serve (such services as accounts receivable) and research, among other expenses.

“By the 1980s, the airline industry understood what many industries would wait years to discover: The computer isn’t just a record-keeping device, but a competitive weapon in the battle for the consumer.”

Scientific pricing is based on optimal inventory management. For an airline, the inventoried item is a seat. The variables can be weekend stays, preferred seating and the availability of refunds. This variety of options evolved after the airlines found that people are willing to pay more for a ticket with certain benefits. As a result, airlines turned to “yield management” or “revenue management” for better governance of how many seats to offer at what prices with which amenities. With these tactics, airlines can maximize their average revenue per passenger per trip, day by day, by studying patrons’ behavior and using the patterns to calculate what fares to offer.

“Research into pricing has grown at a remarkable pace in recent years as academics seek to understand the best way to price everything from insurance contracts to groceries.”

Pricing airline seats resembles pricing other commodities with two pivotal differences. First, an empty seat changes from saleable to worthless when the plane departs. Second, the airline can make a seat more saleable instantly by re-pricing it (based on inventory control). This becomes complex mathematically when an airline operates many flights each day using numerous aircraft. For instance, in 2004, American Airlines (AA) ran 1,013 planes, averaging 130 seats each. Every plane took off twice daily, and customers could reserve seats about a year in advance. This meant that, “on any given day” in ‘04, American handled “an inventory of close to 100 million seats.”

“Just as we successfully use weather predictions to plan our affairs, pricing systems can be powerful tools.”

The typical airline reservation system was not always sophisticated enough to handle constantly shifting tasks this big. American used to manage its seat reservations with an index card system, but those days are long gone. However, until the U.S. deregulated the airlines in 1978, selling a plane reservation was just order taking. For the most part, all tickets cost the same, with discounts for seniors, students and late-night travelers. After deregulation, airlines made a critical distinction between business and leisure travelers. This triggered the pricing revolution. Once airlines could charge different fares to different passengers, they had the financial opportunity to turn losses into profits. This matters because airlines operate on slim profit margins.

“As much as we want pricing science to be as exact as the laws of celestial motion, it’s not.”

Airlines capitalized on the habits of leisure and business travelers. Leisure travelers booked in advance and flew on weekends; businesspeople booked on short notice and flew during the week. Still unsure about charging different prices for the same service, the airlines began offering features that varied with price, such as advance booking or refundable tickets. This drove prices lower. In the years before Internet booking, each airline tried to develop its own travel agents’ reservation system. In 1983, American and United booked 43% and 27% of their respective revenues through these proprietary systems. By 1985, 86% of all airline tickets were sold via travel agents, mostly using airline reservation systems.

“Inventory control is the heart of pricing in the airline industry.”

The advent of widespread Internet use brought greater savings to consumers and airlines. U.S. Airways calculated that it spent \$26 to sell a ticket through a ticket agent, \$21 to sell it via a third party Internet site, \$19 to use a travel agency, and \$11 when passengers used its Web site. The Web also made it easier for passengers to compare the full range of fares for any trip.

“What airlines have done is to completely set aside cost when establishing the price that’s available in the market.”

Computerization enabled the airlines to capture a phenomenal amount of customer data. This fueled scientific pricing, which American Airlines expertly implemented using a system called the “Dynamic Inventory Allocation and Maintenance Optimizer,” which predicts how many high-fare new bookings the airline can anticipate on a specific flight based on past customer usage. Once that number of seats is booked, the airline discounts the remaining seats.

“The Internet unlocked the data floodgates, providing a means to experiment and proactively gather information on what sells.”

Airline pricing analysts and revenue managers work with this data to control inventory levels. For example, they decide how many seats on each plane to allocate to a certain class of refundable tickets. To determine this number, managers check historic data (i.e., how many tickets in a certain class AA usually sells on that flight) and then calculate the probability that it will sell this number of tickets again within a certain time prior to departure. As departure approaches, they adjust the number of available tickets in various price classes to increase revenue. This concept is critical to airline pricing, and now other industries use it as well.

“For consumers, the Internet created unheard-of transparency into ticket prices.”

This approach provides a conceptual framework that airlines use to create models, solve specific problems and identify variables. The objective is “optimal” pricing:

the best solution relative to a stated set of objectives, constraints and assumptions.” Companies use optimization to isolate how much each variable might contribute to or detract from profitability, in light of other measurable factors. For instance, with this model a shipping company can decide if it is better to add additional trucks or extra drivers. Computers make this more efficient since they use optimization techniques to consider every possible answer to complex problems.

Spoke and Hub

Most airlines set up a spoke-and-hub system in which passengers fly to a major city and then connect with flights to less popular destinations. This makes money when all the flights into the hub are booked, although passengers who come to the hub from different places have paid different fares. To manage revenues in such situations, airlines calculate each fare’s opportunity cost (the costs of not using an alternative) and use the information to decide, for instance, whether to deploy larger planes that can take more people into a profitable hub.

“The confusion between price and worth stems from our ethical makeup, demanding that price somehow be connected with the inherent value of an item.”

Airlines also rely heavily on forecasting to evaluate pricing strategies. This is complex, given the array of ticket prices, fluctuating demand and the difficulty of interpreting actual ticket sales. The airlines’ policy of selling only a set number of tickets at a given price may constrain sales. A second problem (since forecasters care what people will pay, not necessarily what they actually pay) is that passengers “buy down”: If they can, they choose cheaper tickets. Airlines also monitor each other’s fares, and incorporate that data into their processes. Since every airline uses this practice, they all make slight changes on their Web sites to confuse any automated price gathering the competition may use. Clearly, pricing science is not perfect.

Trains, Cars, Buses, Boats

About \$1 of every \$10 of the U.S. gross domestic product is spent on travel and tourism, a \$1.3 trillion global business. Today travelers book most of their arrangements through the Internet and other reservation systems. By 2007, about 55% of all ticket sales were made online. The entire travel industry – hotels, car rentals, cruise ships – has now adopted the airlines’ scientific pricing techniques because of their many similarities: fixed capacity, flexible scheduling, time-perishable inventory, low variable costs and the ability to create new products by combining existing inventories (i.e., linking car rental and hotels rates). The math that generates these industries’ prices works about the same way. For example, the hotel industry uses inventory control to prevent “checkerboarding.” If one guest wants a room for a week, while another wants it for only four nights, the hotel has to make the right choice to earn the most revenue. Thus, it may require reservations for a minimum number of nights. Restaurants use a variation of this concept when they host “happy hours,” offering lower-priced drinks at times when their tables are often vacant.

“Justice hinges on the presumption that at a given place at a given time, a just price exists, and it can be reasonably approximated from price information in the market.”

Walt Disney World in Orlando, Florida, uses revenue management to maximize profitability at its restaurants, shops and 26,000 hotel rooms. For example, its industrial engineers measure the amount of time that people sit at restaurant tables (“turn time”), and adjust reservation slots and volume accordingly. Other variables also affect turn time, such as how quickly the food is ordered, cooked and served. Such inventory management helps Disney earn more without raising prices.

What’s It Worth?

Determining the price of an item is not the same as calculating its real value. A fair price is part commerce and part justice. Since the early Greeks, theologians, economists, philosophers and legal scholars have debated the right way to set just prices. This may seem theoretical, but it has ongoing applications. For instance, do the higher prices for groceries after a natural disaster represent gouging or a genuine increase in the suppliers’ costs? It also affects airline prices.

The airline industry focuses on keeping expensive capital assets (airplanes) working to generate revenues. However, airlines don’t calculate fares based on fixed costs, but on the expected number of passengers and their willingness to pay certain amounts. In effect, airlines auction their seats. Their reliance on customer behavior and buying preferences to set prices makes passengers more akin to competitors placing bids at an auction than to shoppers buying tickets. Ticket prices also change so frequently that customers have no reference points for making comparisons or even becoming disgruntled.

Airline fares are determined by a branch of applied mathematics called operation research, a misleading name for a discipline based on mathematics and optimization, using stochastics, statistics, forecasting and computer science. For instance, you stand in a single line to check your bags at the airport, instead of choosing among shorter lines at each clerk’s counter, because operations research has found that one queue is more efficient than several smaller ones. The actual mathematics behind scientific pricing can be summarized with the equation: $R = PQ$, where R is revenue, P is price and Q is quantity. When applied in the traditional demand curve (known as the price response function), this equation illustrates the relationship between price and demand: The higher the price, the lower the number of items sold. When this curve is used in revenue management, it takes on a new meaning. The goal of revenue management is not to sell every item in the inventory, but to segment the market so that the items can be sold at different prices to different customers, thus maximizing the profit for a given inventory.

This means that unsold revenue should not be considered lost revenue. Instead, it should open the discussion about the relationship between price and quantity. In practice, this leads to “dynamic pricing,” the practice of setting different prices for the same product. This is also part of “customer-centric” pricing: charging different prices to different customers for the same item, based on customers’ profiles. This could cause public relations problems, but the courts have said it is legal. Applying such mathematical models to human behavior can make any pricing strategy more sophisticated. It took the airline industry about 30 years to implement scientific pricing. Now other businesses are following suit.

About the Author

E. Andrew Boyd is the chief scientist and senior vice president of a consultancy that works with leading companies on pricing issues. He holds a Ph.D. in operations research from the Massachusetts Institute of Technology.