A Business Overview of Market Adaptive Dynamic Pricing

** Working Draft **

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Abstract
For several years, Sabre has been working on the design and development of new shopping data sources, customer choice models and fare optimization algorithms to help airlines continually adapt their selling price positioning to maximize profits. These market-adaptive dynamic pricing models are emerging as the next wave of advanced pricing and revenue management (RM) science. This paper is intended to provide a brief, business-oriented overview of Sabre’s perspective on how these new tools could be employed by airlines for improved pricing and RM performance in their own and global distribution system channels.

Keywords: Airline Pricing; Dynamic Pricing; Optimization; Price Elasticity; Price Positioning

1 Introduction
The term ‘airline dynamic pricing’ has previously been used in numerous different contexts (usually as some type of automated pricing tool). In this paper, the term ‘dynamic fares engine’ is used to better distinguish our specific framework from the broader category of automated price support. Sabre’s vision of a comprehensive, real-time dynamic fares engine is based on three main components:

- Customer Retailing (e.g. Sabre Dynamic Retailer)
- Accurate inventory controls (e.g. SabreSonic Inventory or Availability Proxy)
- Market Adaptive pricing (customer choice and optimization models considering relative price and schedule quality)

An illustration is provided in Figure 1.

Figure 1: Main Components of a Dynamic Fares Engine

Airline customer retailing involves the support of customer-specific selling strategies including dynamic offer creation and bundling. During the past decade, there has been growing awareness of the importance of retailing in the airline industry. Decision support to design fare products by identifying customer preferences and willingness-to-pay is improving with better approaches to customer segmentation. Standards for new distribution capabilities are being developed by IATA and others which are focused on flexibility in presenting offers to travelers and travel agents. Sabre actively participates in these industry working groups and has introduced new products for airline and agency customers (e.g. Sabre Agency Retailer, Sabre Dynamic Retailer and Sabre Merchandising Manager); these new products help airlines manage and display expanded ancillary and branded fares content as well as other special offers through the Sabre global distribution system (GDS) and airline websites (for Sabre-hosted carriers). Retailing is an important aspect of a general dynamic pricing capability.
A critical element affecting the real-time execution of an airline’s retailing strategy is the accuracy of the product availability information. Incorrect availability information can lead to many problems in a dynamic fares engine. For example, the wrong (or in some cases no) product might be offered to the customer, or inconsistencies can result between the products displayed during the shopping process versus those which are actually bookable. Furthermore, the real-time, market adaptive fares engine requires accurate estimates of marginal cost (i.e. flight bid prices by itinerary). Thus, an effective retailing strategy requires an accurate technical solution for real-time availability information.

Perhaps the most important (but least well known) component of an effective dynamic fares engine is the market adaptive pricing (MAP) module. MAP processing uses real-time (or recent) lowfare search results by market, POS and date to understand an airline’s competitive positioning (considering both price and schedule quality aspects). Customer choice and optimization models are used which consider price, schedule quality and customer segmentation to estimate probability of selection and expected revenue of available itineraries. MAP provides a real-time, ‘sense and respond’ [1] system for maximizing expected itinerary profits (i.e. expected revenue net of estimated flight opportunity costs).

The benefits of effective customer retailing and accurate availability information are well understood by the airlines. As such, the remainder of this paper focuses on MAP, including the processing framework, estimated benefits, and comments by practitioners on the role and future of MAP-like tools are discussed.

2 Market Adaptive Pricing: System Processing

Market adaptive pricing systems consist of three main parts; they are:

- Lowfare Search Shopping data (with information on current competitive conditions)
- Customer choice models
- Price optimization model
Understanding your airline’s current price competitiveness is at the core of market adaptive pricing. Lowfare search results by market, date and point-of-sale (POS) from GDS and third-party robotic vendors are a good source for this type of information because they provide results across multiple airlines. Ideally these shopping data would be comprised of streaming, real-time information, but recent cached results can also be used.

Customer-choice models are a special type of statistical regression model; they are useful in assessing the attractiveness of available airline itineraries to customers considering both price and schedule quality (e.g. departure time, elapsed flight time, number of stops, airline, aircraft type, cabin, interline, codeshare, etc.). A specific (and very useful) function is that, given numerous different flight itineraries (with different prices and schedule quality attributes), customer choice models can estimate the probability of selection for each itinerary. Furthermore, different models can be calibrated for different customer types (to better reflect the differences in the tradeoffs made between business and leisure customer segments). These types of models are becoming increasingly popular in modern RM systems; e.g. see [2] and [3].

Whereas choice models provide a capability to estimate selection probabilities considering competitor offerings, price optimization models optimize airline itinerary prices based on (intuitive) tradeoff between selection probability and yield. If an airline increases its itinerary prices, the customer selection probabilities for that airline will drop. Conversely, if an airline decreases its itinerary prices, the selection likelihood increases. The price optimization engine recognizes these tradeoffs and can search along the entire spectrum of possible price points to find the set of itinerary prices that maximize expected profit (conditional on the price and quality of other airline itineraries that are currently available). Expected profit (for your airline) is the sum of your itinerary expected revenues less the associated flight bid prices. A provably effective heuristic for dynamic price optimization considering these factors is described by Gallego and Hu in [4]; their heuristic is bi-directional in that it can be used to identify both uncompetitive (i.e. recommended price decreases) and overcompetitive (i.e. recommended price increases) carrier itineraries.

¹Note: an airline’s own website is typically a very poor source for understanding competitive positioning owing to both bias and a lack of other airline content.
An illustrated example of shopping data results and how they are used in MAP is provided in Figure 2. In this Frankfurt to Istanbul example, the first itinerary (Lufthansa) is the lowest priced and non-stop. Considering these factors, the customer choice model will give this itinerary a high selection probability. The obvious business question to ask: ‘is an additional price premium possible by Lufthansa?’ By inspection, it is clear that, unless Onur Air (8Q) has a strong natural preference in this market (or mid-afternoon flights are deemed more desirable than early evening ones), then there is room to increase the Lufthansa price by at least $6 dollars (to close the gap with the next best alternative). Conversely, the fourth alternative (Ukraine International Airlines) has a high price and relatively poor schedule quality (due to a connection in Kiev); furthermore, since PS is not a flag carrier in either FRA or IST, we would expect a relatively low selection probability for this market and flight date. So for the fourth alternative, unless the flight bid prices (and associated opportunity costs) are high, a price optimizer would likely recommend price reductions to improve PS expected profitability for this market and date.

![Figure 2](image)

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**Figure 2**: Lowfare Search Shopping Result for FRA-IST on 23FEB (POS=US)
3 Market Adaptive Pricing: Business Considerations

For an airline, there are several important advantages to using dynamic pricing:

1. Dynamic pricing enables an airline to provide a fare quote along the price demand continuum. By eliminating discrete price points typically shown on a theoretical price demand curve, dynamic pricing helps airlines to capture the lost opportunity by overcoming discrete price points. Dynamic pricing also helps the consumer by providing a price point that is closer to their true willingness to pay.

2. Today the RM availability determination process and pricing an itinerary are discrete steps and not linked to each other; e.g. the ticketed price after evaluating sum-of-locals subject to fare combinability can be lower than the total bid price for the itinerary. In addition to better consistency, the recommended dynamic price will also be the ticketed fare.

3. Unlike traditional revenue management and inventory control, decision making with dynamic pricing is at the more detailed, round-trip level. This finer degree of control can drive additional revenue benefits [5].

In their 2005 future outlook paper [1], the authors state that: ‘The likely evolution of airline pricing and revenue management over the next five years can be summarized in two words: competitive awareness’. The authors further describe the emergence of ‘Smart’ controls for real-time availability and pricing adjustments. This view is echoed in a 2004 paper by Dennis Cary [6] where he states: ‘Revenue management, on the other hand, is decidedly myopic. Most RM systems and processes have an inherent assumption that historical trends will continue. In a business where schedules and prices are constantly changing, such an approach seems narrow minded.’ Cary recognizes that building the new systems to manage and act upon competitive data in a meaningful way is difficult, but the payoff should result in improved revenue results for the ones who can figure it out. Another author (Rick Zeni) states in his 2007 paper [7]: ‘Armed with this knowledge, airlines can set prices to capture the willingness of the customer to pay for certain attributes. Customer choice models are methods used to assimilate this data and produce pricing recommendations.’
A similar MAP engine design is described by Fiig in [8] in which he states that dynamic pricing complements (existing) RM; the author's approach maximizes contribution within the session for the travel solutions considered including current competitor information and real-time pricing. Fiig’s research indicates that the distribution of MAP model recommendations is typically bi-directional; unless otherwise constrained, MAP opportunities include both price decreases (for more sales) and increases (for improved yield). Both Fiig and another author (Karl Isler [5]) believe the move to dynamic pricing will be disruptive to current off-line agency workflow and GDS processes; in fact, Isler cites the lack of a clear industry standard regarding round-trip inventory controls is one such barrier delaying the adoption of dynamic pricing.

Despite these obstacles, there is strong evidence pointing towards considerable, positive business impacts from adopting a dynamic fares engine solution. Price repositioning based on current competitive marketplace conditions is potentially of high business value. Internal Sabre and other studies (e.g. [8]) indicate potential revenue improvements ranging from 2% - 10% (arising from both yield and load factor improvements). Such gains are large in comparison to both RM and retail improvements; furthermore, the evidence suggests these gains are in addition to those arising from RM and retailing.

Clearly, more work remains in designing a complete, end-to-end, real-time processing solution for dynamic pricing. However, numerous parties across the industry are actively working in this area (including Sabre), and it is the hope of the author that common, industry standards will emerge in the next few years to accelerate the adoption of these new tools.

References


