Chapter 8.9
Advances in Data Processing for Airlines Revenue Management

Félix Mora-Camino
French Civil Aviation Institute (ENAC), France

Luiz Gustavo Zelaya Cruz
Federal University of Rio de Janeiro, Brazil

ABSTRACT

In this communication advances in data processing techniques applied to Airlines Revenue Management are displayed. The general introduction presents a brief review of Airlines Revenue Management. The first of the paper introduces the problem of updating the probability distributions of demand for reservations. This updating process, facing the stochastic nature of demand for travel, is a cornerstone for the design of an efficient on-line decision support system to control the reservation process for a flight by an airline. The considered problem is formulated as a dual geometric problem to which an unconstrained non-convex, primal geometric problem is associated. A genetic algorithm optimization approach is proposed to solve the primal geometric problem, and then the classical geometric primal-dual transformations provide the solution to the initial problem. Then, the second part of the paper considers the design of a new Decision Support System for improving the reservation control process of airlines. A new recursive Dynamic Programming model for maximum expected revenue evaluation is defined, which, contrarily to other approaches, takes explicitly into account daily booking request arrivals. A practical Backward Dynamic Programming algorithm is established, leading to the design of an on-line optimisation module for Revenue Management. In this study two cases are considered. The first one considers that fare classes are not physically confined and the obtained results are extended in the second case to cover the situations where confinement of fare classes (Business Class and Economy Class) is applied.

DOI: 10.4018/978-1-61350-456-7.ch8.9

GENERAL INTRODUCTION

During the last forty years which followed the first publications about booking control, the passenger booking systems have known a large evolution as a result of the development of computer science and telecommunications technologies on one side and of demand and decision theories on the other side. This evolution has touched not only the level of basic inventory control but also the level of higher strategic decision making. Revenue Management appeared as a major matter for airlines with the Airline Deregulation act of 1978 in the United States of America. Since then, it has taken an increasing importance, especially in the context of the competitive market faced by airline companies. Born as a consequence of the Airline Deregulation Act of 1978 in the USA, called in its early days *Yield Management*, nowadays known as *Revenue Management* (McGill & van Ryzin, 1999), the new management technique which has revolutionized airline industry and many other perishable-asset industries is meant to maximize revenue on a company's network of flights, by finding the optimal passenger mix for each flight, given the demand forecasts for each of the different fare products offered to customers. In other words, the reservation process has to be controlled and implemented within a complex decision support environment which should be able to make, on-line, the right decision with respect to any booking request received by the Computer Reservation System (CRS) at any point in time during the booking horizon.

Today, the huge development of new communication devices, such as the Internet, which are used by more and more potential customers, contributes to make the flight/airline choice process more efficient in the context of a quasi-perfect information situation. Under these terms, the design of new decision support systems, providing optimal seat inventory control processes with real-time capabilities, becomes unavoidable to meet the harsh competition from concurrent transporters.

The first part of the communication is devoted to the problem of updating the probability distributions of demand for reservations. In fact, when considering Airlines' Revenue Management, demand forecasting is a prerequisite to establish booking limits and overbooking levels. Before the seventieth, almost all the research in this field was focused on the subject of overbooking control, but afterwards, many research works about detailed demand forecasting techniques applied to the number and the distribution of bookings, booking cancellations, no-shows and go-shows, were developed. The forecast of air transportation demand is a very difficult task since it has to take into account a multiplicity of complex factors such as distribution of fares and routes, seasonal effects, time schedules etc.

In order to take into account the highly stochastic nature of booking requests, forecasts should be updated with the latest information available to improve the efficiency of the Revenue Management decision process.

The second part of the paper is devoted to the design of a new Decision Support System for improving the reservation control process of airlines. Many design studies for on-line Revenue Management have been performed, some of them particularly towards the implementation of the Dynamic Programming technique. Here a step further is taken in this direction, by the proposal of a new recursive model for the maximum expected revenue evaluation which, contrarily to other approaches, takes explicitly into account daily booking requests arrivals. The optimisation module of the Revenue Management System works on-line. It gathers as input all the most recent updates provided by a demand forecasting function, as well as the present state of the reservations, to proceed with an optimisation algorithm in order to treat in an efficient way new requests. The temporal (daily) dimension of the reservation process in the airline industry has to be taken into account for a realistic implementation of any optimisation method. The Dynamic Programming technique,