The continuing evolution of revenue management science

Ian Yeoman¹

Accepted: 13 January 2022 / Published online: 17 January 2022
© The Author(s), under exclusive licence to Springer Nature Limited 2022

From airline revenue management through to restaurant revenue management, the evolution of revenue management in the last 20 years has become more important as business adopts more efficient and scientific means to manage inventory. In this issue, we highlight a number of papers that represent that application and evolution as the science of revenue management is established as mainstream and essential. One of the core revenue management problems in the airlines has been cabin configuration.

The aim of the problem is to maximize the total revenue of an aircraft with multiple cabins by sharing the seats of a higher service cabin with passengers who book in the fare classes corresponding to a cabin that offers lower service standards. The main assumption for this approach is that passengers booked in the economy cabin will accept to be upgraded to a cabin that offers better service. Escovar-Álvarez and Belobaba's (2021) explore the multiple cabin revenue management problem focusing on the case of airlines operating dual cabin aircraft. Instead of splitting passengers into categories as in Alstrup et al. (1986) passengers in the authors simulations make their decisions based on their characteristics (e.g., willingness to pay, disutilities) and on the options made available by the airlines. The results highlight the impact on revenues of the constraints imposed by the division of the aircraft into fixed cabins and premium cabin capacity. Sharing schemes were proposed for taking advantage of available premium cabin seats to accommodate additional passengers with bookings in economy fare classes. The expectation is to increase the revenue generated from the premium cabin by adding passengers with bookings in economy fare classes to the passengers that would have been expected to buy premium fare classes (fare classes 1 to 4) when cabins are managed distinctly. Full EMSR (Belobaba 1987) was for the premium cabin capacity sharing

mechanism for leg-based RM, and Effective Bid Price capacity sharing is designed for OD-control RM. The results of the simulations in PODS show that if capacity is shared from the beginning of the booking period, both mechanisms result either in a decrease or a negligible increase in total flight revenue (depending on the demand level).

One of the innovate applications of revenue management in the last decade has been in the restaurant business. Restaurants face various capacity constraint problems (Desiraju and Shugan 1999) and the unique characteristics of restaurants such as flexibility in meal duration and more flexible capacities have seen the reformulation of revenue management led by Professor Sherri Kimes from the Cornell Hotel School (Sheryl et al. 2002; Sheryl and Jonathan 2013). Tyagi and Bolia's (2021) identify a number of emerging research themes in this application. First, the authors call for deeper research into determining pricing strategy and designing appropriate price fences focused on preferences and appropriate designing of rate fences. Second, developing overbooking models for full-service restaurants. The future studies on overbooking should include complexities such as customer response to increased wait times and the effect of an overbooking policy on the no show rate. Third, online food ordering system has hugely taken off since COVID-19 and restaurateurs are currently paying hefty commissions to third-party service providers which can ultimately lead to the loss in revenue of the restaurants. This should focus on the integration pricing policies, discounts, offers, and bundling of the menu items) based on customers' preferences. Finally, future studies could focus on the perceived fairness of revenue management policies and recommend strategies to optimize costs and prices without creating a negative perception among the customers.

It has always been a case that seasonality is an inherent issue in the hotel industry. Alrawabdeh (2021) proposes a model that tests the balance of seasonal demands and prices to maximize hoteliers' profit. Specifically, the authors present an approach that finds the seasonal elasticity of demand at the optimum profit. Kastius and Schlosser (2021) raise the debate about dynamic pricing as a possibility to gain

✉ Ian Yeoman
ian.yeoman@vuw.ac.nz

¹ Wellington School of Business and Government, Wellington, New Zealand

an advantage over competitors in modern online markets. The past advancements in Reinforcement Learning (RL) provided more capable algorithms that can be used to solve pricing problems. In this paper, the authors study the performance of Deep Q-Networks (DQN) and the Soft Actor Critic (SAC) in different market models and under certain conditions.

Although prices are the most discussed topic in consumer conversations, research has mostly neglected the field of price-related word-of-mouth (WOM). Schneider and Huber's (2021) study picks up this research gap by analyzing the effects of price-WOM valence and price change communicated by WOM on consumer price perception. Fare allocation for legs and O&D pairs plays a crucial role in airline revenue management. Despite a large number of dynamic pricing studies, there are only a few widely adopted studies in which assumptions affect most tactical decisions with potentially large impacts on airline profitability. Korkmaz et al. (2021) propose a fare allocation model for a single leg in the presence of a realistic nonhomogeneous Poisson demand with an increasing rate. The aim of the model is to compute when and how to markup the price for an airfare product (switch to an upper fare class) to maximize the expected revenue. The finding proposes a dynamic look-ahead pricing scheme to compare our fluid approximation results against the well-known EMSRb (Lawrence Weatherford 1995; Larry Weatherford 2016; Zhang and Kalllesen 2008) heuristic and a dynamic programming solution on randomly generated booking request data. Chiang and Cheng's (2021) study aims to apply the bi-level game theory model to explore how a hotel collaborates with third-party websites to determine the optimal room rate and the number of overbooking to maximize the hotel's total profit. The results show that the proposed bi-level game model not only can provide optimal room rate and the number of overbooking to the hotel but also the marketing efforts to third-party websites. Mushtaque and Pazour's (2021) paper focuses on an assortment of optimization problems concerned with the three ways a recommender system increases conversion rates; namely improving accuracy, consideration sets, and novelty—diversity. Taking a value that a customer derives from an assortment, the authors explore trade-off between recommending items with high profit margins, but low consumer choice probability. They present a polynomial-time algorithm to solve the optimization models.

Revenue and Pricing Management. <https://doi.org/10.1057/s41272-021-00290-6>.

- Alstrup, J., S. Boas, O.B.G. Madsen, and R.V. Vidal. 1986. Booking policy for flights with two types of passengers. *European Journal of Operational Research* 27 (3): 274–288. [https://doi.org/10.1016/0377-2217\(86\)90325-5](https://doi.org/10.1016/0377-2217(86)90325-5).
- Belobaba, P. (1987). *Air travel demand and airline seat inventory management*. (PhD), Massachusetts Institute of Technology, Cambridge. Retrieved from <http://hdl.handle.net/1721.1/14800>
- Chiang, C.I., and Y.H. Cheng. 2021. On the Stackelberg game model of the collaboration of a hotel and third-party booking websites. *Journal of Revenue and Pricing Management*. <https://doi.org/10.1057/s41272-021-00283-5>.
- Desiraju, R., and S.M. Shugan. 1999. Strategic service pricing and yield management. *Journal of Marketing* 63 (1): 44–56. <https://doi.org/10.1177/002224299906300104>.
- Escovar-Álvarez, G., and P.P. Belobaba. 2021. Premium cabin capacity sharing strategies: Airline RM insights. *Journal of Revenue and Pricing Management*. <https://doi.org/10.1057/s41272-021-00326-x>.
- Kastius, A., and R. Schlosser. 2021. Dynamic pricing under competition using reinforcement learning. *Journal of Revenue and Pricing Management*. <https://doi.org/10.1057/s41272-021-00285-3>.
- Korkmaz, S., O.E. Kundakcioglu, and O. Sivrikaya. 2021. A fluid approximation for the single-leg fare allocation problem with non-homogeneous poisson demand. *Journal of Revenue and Pricing Management*. <https://doi.org/10.1057/s41272-021-00284-4>.
- Mushtaque, U., and J.A. Pazour. 2021. Assortment optimization under cardinality effects and novelty for unequal profit margin items. *Journal of Revenue and Pricing Management*. <https://doi.org/10.1057/s41272-020-00279-7>.
- Schneider, S., and F. Huber. 2021. You paid what!? Understanding price-related word-of-mouth and price perception among opinion leaders and innovators. *Journal of Revenue and Pricing Management*. <https://doi.org/10.1057/s41272-021-00289-z>.
- Sheryl, E.K., W. Jochen, and M.N. Breffni. 2002. How long should dinner take? Measuring expected meal duration for restaurant revenue management. *Journal of Revenue & Pricing Management* 1 (3): 220. <https://doi.org/10.1057/palgrave.rpm.5170026>.
- Sheryl, E.K., and B. Jonathan. 2013. The future of restaurant revenue management. *Journal of Revenue and Pricing Management* 12 (5): 464. <https://doi.org/10.1057/rpm.2013.22>.
- Tyagi, M., and N.B. Bolia. 2021. Approaches for restaurant revenue management. *Journal of Revenue and Pricing Management*. <https://doi.org/10.1057/s41272-021-00288-0>.
- Weatherford, L. 1995. Length of stay heuristics: Do they really make a difference? *Cornell Hotel and Restaurant Administration Quarterly* 36 (6): 70.
- Weatherford, L. 2016. The history of forecasting models in revenue management. *Journal of Revenue and Pricing Management*. <https://doi.org/10.1057/rpm.2016.18>.
- Zhang, D., and R. Kalllesen. 2008. Incorporating competitive price information into revenue management. *Journal of Revenue and Pricing Management* 7 (1): 17–26. <https://doi.org/10.1057/palgrave.rpm.5160120>.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

References

- Alrawabdeh, W. 2021. Seasonal balancing of revenue and demand in hotel industry: The case of Dubai City. *Journal of*