# How far will the airline model stretch?

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## Abstract

As revenue management matures, the growth in the number of industries it is employed in is slowing and questions are being asked about its effectiveness in situations that are very different from the traditional airline model. The revenue management industry and academics must move away from solving problems for the airlines and concentrate on building better, more specific models, for other key industries.

## Introduction

Recent meetings of Revenue Management and Pricing International (RMAPI, previously known as the Revenue Management Society), a society made up of senior Revenue Management (RM) executives from across the UK, suggest a move away from buying off-the-shelf packages in favour of development of bespoke software. This seems to be particularly true of non-standard RM industries, e.g. tour operators, media, rail. Frequently, the reasons stated for opting to build a system from scratch are the lack of fit between the assumptions and outputs of an off-the-shelf package and reality; and the lack of transparency in the calculations. Both of these observations are backed up by recent Futures articles in this journal (Dorhout, 2014 and Westermann 2013). In this article we discuss how the key challenges in RM are changing from expansion across a range of industries to improving the specification of tools for each individual situation.

## Core RM Values

An organisation that makes use of RM techniques aims to sell a fixed capacity of one or more perishable products, and must set the price or allocation accordingly. Other features of the system will be specific to the industry and also to the particular organisation involved. Integral to these core RM values are a set of heuristics that brought success to the airlines, e.g. EMSR (Belobaba, 1989) and Littlewood’s Method (Littlewood, 1972). These still have a role to play as excellent approximations of how to optimise the allocation of fixed capacity between different product classes. More recently, work on choice modelling (Vulcano et al. 2010) shows how customer choice can be incorporated into RM systems, where the choice is based on user-specified product features. Although developed for the airlines, these algorithms solve the RM problem inherent in many industries: selling a fixed capacity of products to maximize revenue and, in the second case, in the presence of customer choice.

The basic RM problem is applicable across a wide range of industries and this fact has been actively exploited for some time, particularly by software vendors. Developing an RM system from scratch which is scalable, fits with other business processes and uses the best optimisation methods is a difficult and costly process, and being able to use the same underlying engine across different industries allows a software vendor to recoup its initial investment. However, like the well-known statement that a 20% reduction in forecast error can lead to a 1% increase in revenue (Poelt, 1998), building a successful RM system designed specifically for a particular industry or even for a particular organisation, where every part of the system is carefully chosen to fit, is likely to result in an increase in revenue.

## Celebrating the Differences

Every RM system will have some of the core set of RM techniques as its basis, but ignoring the particular features of both the industry and the organisation running the RM will render these next to useless. In a recent article (Dorhout, 2014), Pieter Dorhout makes this point for the rail industry, and discusses the careful adaptations that need to be made when implementing RM in different train operating companies.

We describe the problems faced by two other industries that are key users of RM techniques, but work with particularly complex issues: tour operators and cruise liners. Rather than focusing on what is done now, we discuss what could be done in the future.

### Tour Operators

Tour operators typically sell space on flights and in hotels, and excursions or extras, with hotels and flights tying up the majority of the revenue in most cases. Consequently, a holiday is a combination of a few different products. This impacts on the optimisation problem in a number of different ways:

* Multiple capacity constraints: flights and hotels
* If each combination of products is viewed as a holiday, the number of holidays available is huge and the demand for each is small and volatile
* Highly competitive, but because of the variety of holidays on offer, it is less obvious which holidays are the direct competitors
* Highly seasonal

These characteristics may well dominate over the core RM problem, making issues such as forecasting and customer segmentation much more important. Deciding how best to use the data for forecasting seems particularly interesting as using data from individual holidays is unlikely to produce accurate predictions, and so some amalgamation is needed whilst ensuring that the data being amalgamated are homogeneous. Getting this right also allows tour operators to have a better understanding of who is competing with them. It may also allow whole sets of holidays to be managed together.

### Cruises

The cruise industry has been growing steadily since the 1980s and estimates suggest that 21.6 million passengers were taken on cruises in 2014 (Cruise Market Watch, 2014). The differences that are likely to affect the key analyses of the data and the optimisation of prices appear to be the following.

* Multiple capacity constraints: cabins and lifeboats
* There is much more potential for selling ancillary products on board a cruise ship, e.g. food and drink, entertainment and the whole value of a customer (fare plus expected spend on ancillary products) should be taken into account when setting fares or capacity constraints
* The majority of bookings are taken between January and March making demand forecasting and dynamic pricing more difficult

A detailed discussion of RM for cruise ships is given in Maddah et al. (2010) which provides a longer list of differences between cruise ship RM and airline or hotel RM as well as optimisation methods for maximizing revenue with the two capacity constraints. As the authors state in their article, given the size of the cruise industry, relatively little research has been done into how best to manage its RM, possibly because the difficulty of the problem makes it harder to develop elegant mathematical solutions.

## Conclusion

The underlying methods of core RM are well-known and work well on the general problem of selling a fixed number of perishable goods to maximize revenue. Over the past 20 years, these methods have been extended to a huge range of industries from airlines to media, car hire to air cargo, and the range of applications is still increasing.

The rapid rise in RM applications has slowed in recent years and it seems reasonable to assume that most of the obvious applications have now been exploited. Consequently, the next phase for RM must be consolidation. Now that we have proved that the core RM toolset works for a wide range of different industries, more time needs to be spent fitting the methods to the different situations, e.g.

* Taking account of the huge number of origin-destination pairs in rail
* Fairly pricing the many different holidays on offer from tour operators, where demand for each individual holiday is relatively low
* Taking account of multiple capacity constraints
* Treating vehicles on ferries and cargo as variable-sized entities rather than identical products

 To paraphrase a well-known quote: we should be fitting the right model, to the right situation, using the right data, and only by increasing fundamental research in industries other than the airline industry will achieve that.

## References

Belobaba, P.P. (1989) Application of a probabilistic decision model to airline seat inventory control. *Operations Research* 37(2): 183-197.

Cruise Market Watch (2014) <http://www.cruisemarketwatch.com/growth/> , accessed 28 November 2014.

Dorhout, P. (2013) Building rail revenue management on an airline foundation – Choosing wisely from a mixed bag. *Journal of Revenue and Pricing Management* 13(3): 261-264.

Littlewood, K. (1972) Forecasting and control of passenger bookings. In AGIFORS Symposium Proceedings, pp. 95-117.

Maddah, B., Moussawi-Haidar, L., El-Taha, M. and Rida, H. (2010) Dynamic cruise ship revenue management. *European Journal of Operational Research*, 207: 445-455.

Poelt, S. (1998) Forecasting is difficult – especially if it relates to the future. In Reservations and Yield Management Study Group Annual Meeting Proceedings, AGIFORS, Melbourne, Australia.

Vulcano, G., van Ryzin, G. and Chaar, W. (2010) Choice-Based Revenue Management: An Empirical Study of Estimation and Optimization. *Manufacturing and Service Operations Management* 12(3): 371-392.

Westermann, D. (2013) The need for improved visualization. *Journal of Revenue and Pricing Management* 12(2): 201-203.