

Rail Yield Management at Trenitalia

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Yield management (YM) is an umbrella term for a set of strategies that enable capacity-constrained service industries to realize optimum revenue from operations. In particular, Rail YM aims at maximizing revenues on each given combination train/date of departure by optimally managing the seats availability per Origin-Destination (O&D) or per leg at each price level through the booking horizon. Within the Transportation YM problem, the Rail YM differs slightly from the Airline YM because, while the perishable and fixed offer is constrained by leg, here the demand is O&D related. Moreover, given the social impact of the rail transportation system, prices fluctuations need to be limited, while the fares availability must be perceived as "fair" by customers.

Since 2005 Trenitalia, main Italian railway undertaking, operates a YM System (YMS) developed by IBM, further adapted to a rail-company needs and integrated with the Sales & Reservation System, with a cooperation between IBM and the "Demand Analysis & Revenue Management" structure of Trenitalia; both the authors were part of the project since its inception in 2004.

The YMS is able to optimize the capacity allocation per O&D based on a fixed fare family clustered structure. Starting from a defined set of sound business rules, the YMS (i) provides the forecast of the potential demand -additive with unconstraining and multiplicative corrections- at each point of the 'load curve', (ii) optimizes the capacity allocation per origin-destination during the booking horizon, based on a fare family clustered structure, and a set of defined business rules, through a stochastic optimization approach, (iii) simulates the effects of the new set of inventory controls, resilient with distinct orders of arrival, in the context of a partial nesting among O&D and fares, (iv) monitors the presence of spill, spoilage and stifling and the results achieved both of the YMS and the analysts through performance indicators and a revenue opportunity estimation. Competitor and price/time sensitivity information integrate a full automated system.

The two-stage, scenario-based stochastic model at the very core of the system is fairly simple in its logic, and is represented as a linear program, taking into consideration O&D, fares, scenarios, and legs. Protection levels are set against dilution, with a partial nesting technique, which uses a variable nesting order, which is computed using the opportunity costs from the stochastic optimization instance.

In 2014 the YMS managed dynamically around 230 trains average/day which carried more than 50 million passengers. The system optimized approximately 4 Million instances of the model, leading to nearly 120 Billion of train-date-class-O&D-fare-quantity decisions ! The system provided satisfactory results through a crucial decade for the former monopolist Trenitalia, with the opening of High Speed lines, and the competition on Italian high-speed routes with the newcomer Nuovo Trasporto Viaggiatori entering the market in 2012.

References

- [1] Gliozzi S., Marchetti A. M., A new Yield Management Approach for Continuous Multi-Variable Bookings: The Airline Cargo case, Kluwer Academic Publisher, in: Operations Research in Space and Air, ISBN/ISSN 1402012187, 2003.
- [2] I.B.M., US Patent: US 7,430,518 B2 (Sept. 30, 2008) and US 8,117,055 B2 (Feb. 14, 2012). US Patent O_ce 2008-2012.