Fare level optimization with continuous demand-revenue curves and bid prices

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Presenter’s bio

- PhD in Physics, University of Debrecen, Hungary
- Experimental physicist in Hungary, Austria, and Switzerland (CERN)
- Lufthansa Systems Hungária: Method Expert (*ProfitLine/Yield O&D*)
- (other stuff)
- Air Berlin: Senior Analyst in OR & Systems @ RM (*PROS OD III*)
- Finnair: Senior Manager in OR & Insights @ RM (*Amadeus NRMS*)

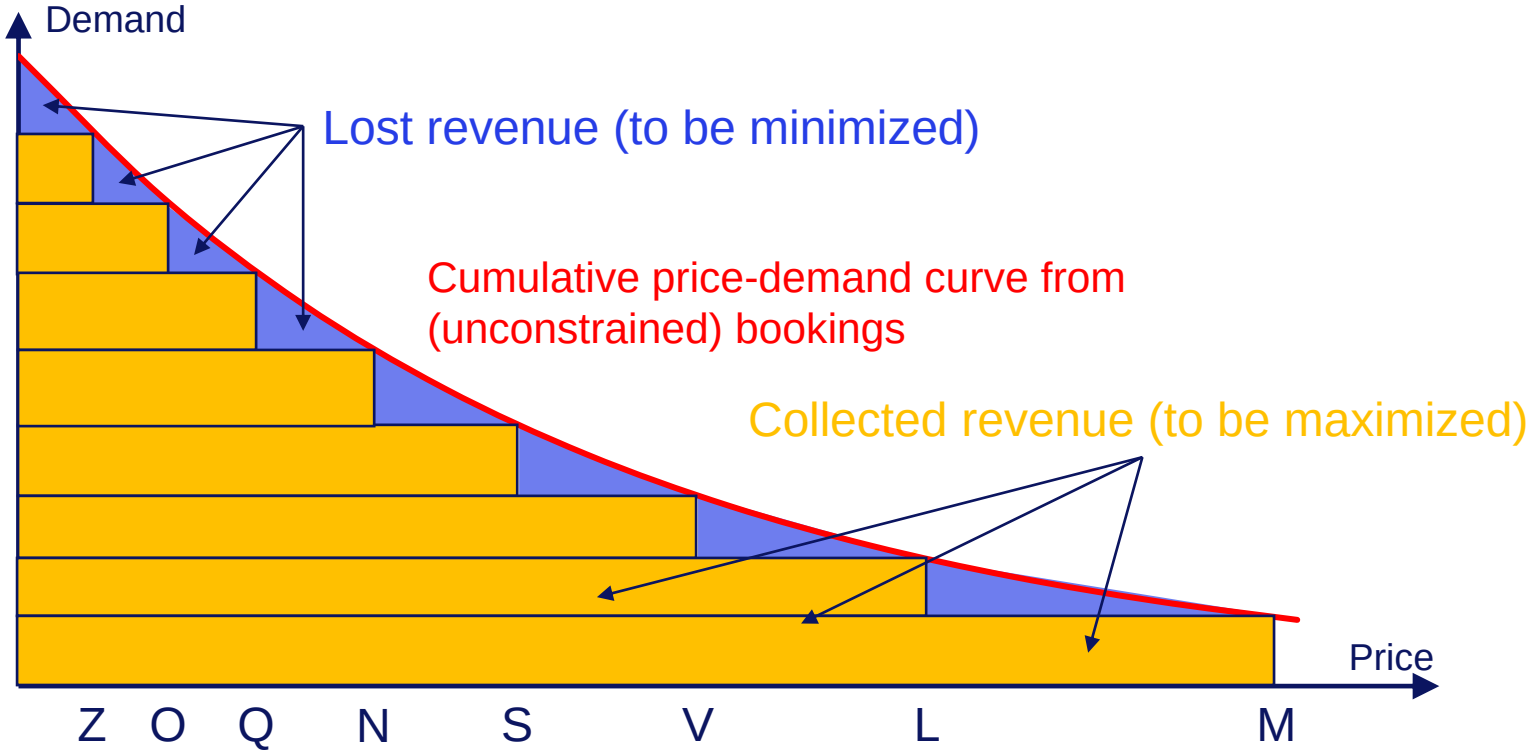
Motivation

- As long as we don’t have continuous pricing, the fares which we file remain important
- If we cannot offer exactly the perfect fare, we lose some revenue ➔ Fares per RBD (“fare levels”) should be optimized to minimize the lost revenue

Limitations:

- There are many fares filed per RBD
  - Single average RBD yield used by our method must be correct
  - Our method does not tell us how to convert single “fare” per RBD into multiple fares

Traditional fare level optimization approach

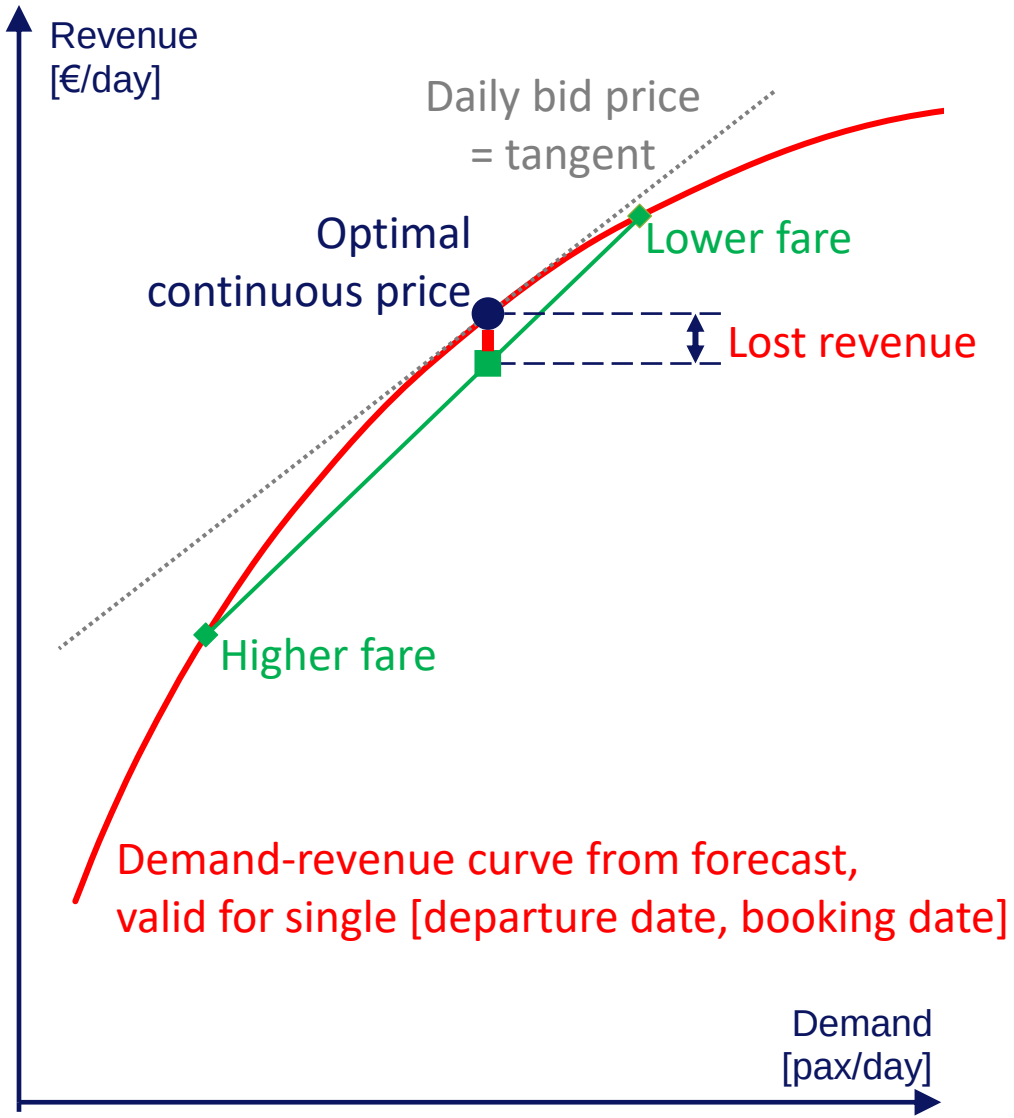


Problems:

- Assumes demand/passengers in RBDs can be perfectly segmented with *rules* or *time*
- No time dimension in price-demand curve
- Capacity constraint not taken into account
- Need to manually set minimum and/or maximum fares

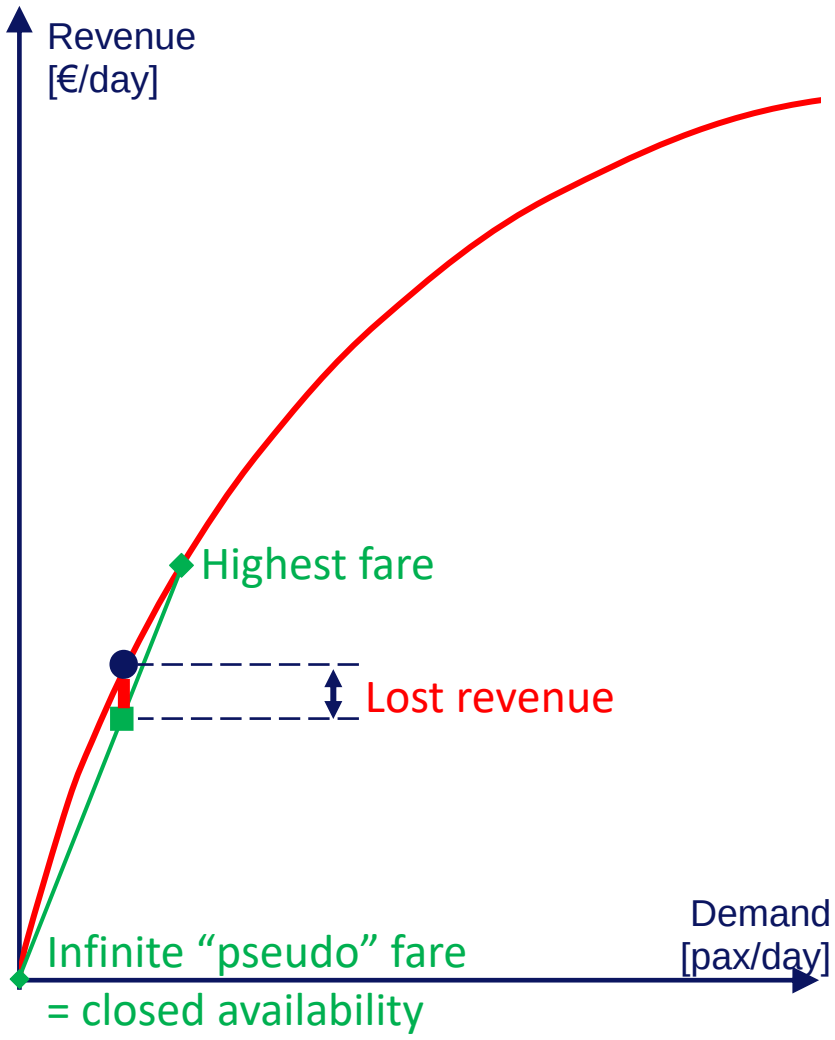
New fare level optimization method

1. From marginal revenue transformation theory: optimal continuous price is where tangent of (forecasted) **daily demand-revenue curve** is equal to (current or future estimated) **bid price**
2. "Mix" lower and higher fares such that the resulting *demand* is the same as the demand with the optimal continuous price
   - Booking intake remains the same (i.e. optimal)
3. Revenue with mixed fare will be on straight line below convex demand-revenue curve
   - Small amount of revenue is lost
4. Find set of fares which minimizes the sum of lost revenues aggregated over all future [departure date, booking date] combinations

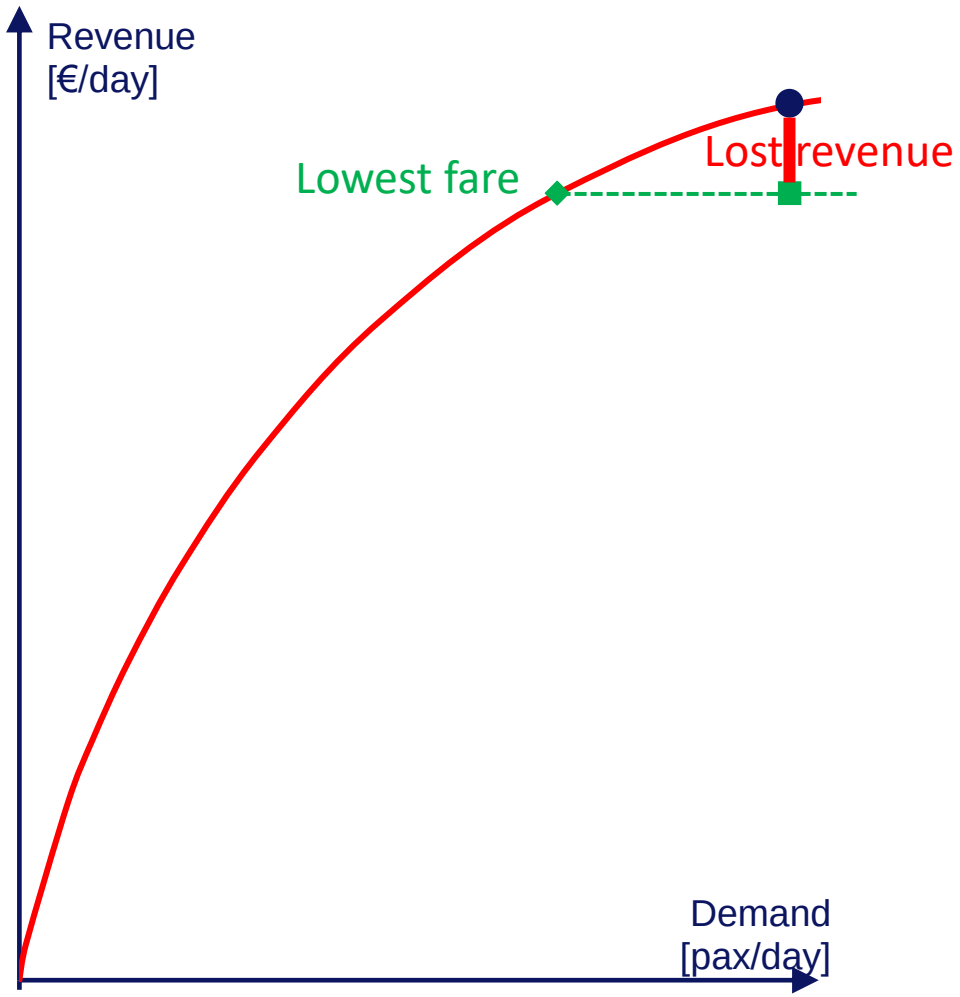


Special cases

Optimal price is higher than highest fare:



Optimal price is lower than lowest fare:

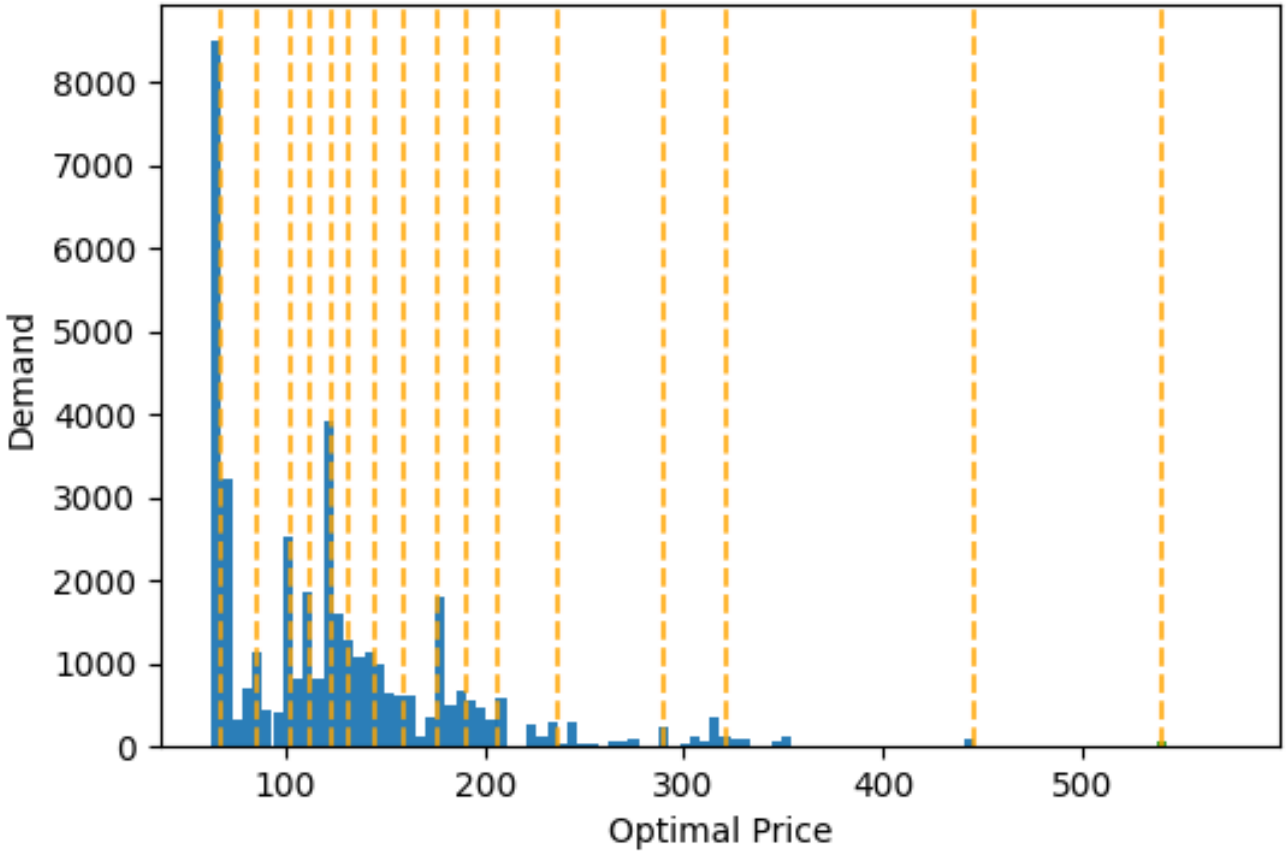


Advantages

- Uses forecasted demand instead of past bookings
  - We can optimize the fares for the future
  - Having correct **demand forecasts** and **yields** is critical
- Takes into account capacity constraints via the bid price
- No need to manually set the lowest and highest fares for the optimization algorithm
  - Less ambiguity

Optimization results

Histogram of optimal continuous prices, weighted with demand



- Fares of higher RBDs almost always go down
- Fares of lowest RBDs almost always go up slightly
- You can lose a lot of revenue if optimal price is much higher than highest fare
- Decrease of revenue loss: 70-80%
- Increase of revenue: 0.5-1%

Open questions

- Can we really mix fares?
- Is the optimal mixed demand the same as the demand with the optimal continuous price?
- When optimal continuous price is below the lowest fare, the demand will be higher than the optimal demand:
  - Is this a big problem, or negligible?
  - Can it be avoided?
- Revenue with discrete fares is lower than with continuous prices ➔ Bid prices will also be slightly lower ➔ Optimization needs to be run iteratively
  - Is this a large effect, or negligible?

Thank you!