



## Overbooking by Airlines

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Airlines set flight reservation levels higher than seating capacity to compensate for passenger cancellations and no-shows. On an average, about half of all reservations made for a flight are cancelled or become no-shows. Without overbooking, about 15% of seats would be unused on flights sold out at departure. Overbooking is used by airlines to improve seat utilization.

### Objective

A large airline decided to use optimization techniques to control and manage reservations inventory in a way that maximizes company profitability, given the flight schedules and fare structures. The objective was to find a solution **that maximizes the net revenue associated with overbooking decisions.**

### Solution

#### Approach

An optimization model **that balances the additional revenue that can be gained by selling a reservation against the cost of the additional oversale risk** was developed. As the overbooking level increases, net revenue increases to a maximum value and then decreases as the incremental cost of an additional sale exceeds the value of an additional reservation. The optimal level occurs at the point where the marginal revenue gained from allowing an additional reservation equals the marginal cost of an additional oversale.

The number of oversales allowed by this unconstrained optimization model may sometimes degrade passenger service to an unacceptable level. To prevent this problem, a constraint was placed on the system to limit the expected number of oversales on each flight using the Lagrangian relaxation.

#### Constraints used

The overbooking model developed took into consideration the following complexities and constraints of the system

- Additional revenue generated by allowing more reservations
- Probability of cancellations and no shows
- Expected number of oversales
- Expected oversale costs
- Maximum oversales allowed
- Recapture probability

Some of the data required by the model came from transactional systems at the airline, while the rest had to be estimated.

- Cancellation and no-show probabilities were estimated using exponential smoothing models with multiplicative day-of-week adjustments and special default rules to handle special situations
- Recapture probabilities were estimated using a passenger choice model

The model was **dynamic** in nature as the factors in the model vary with the amount of time before departure. Overbooking levels had to be recalculated several times before departure

### **Benefits**

- The number of empty seats on sold-out flights reduced from 15% to 7 %, and later to 3% by adding further complexities to the system
- Capital asset utilization increased by 10%
- Involuntary oversales reduced by 62%
- Improved customer satisfaction
- Formalized decision making at the hands of front-line employees

The implementation opened the doors for further application of analytics for improved decision making in areas like discount seat allocation, multiple fare types and traffic management