White Paper

A Look At Cargo Revenue Management

A discussion of revenue management for air cargo businesses

In the early 1980s, revenue management disciplines were first applied in the airline industry as a method to increase revenues resulting from passenger sales. With the success of revenue management to improve passenger revenues, these techniques were applied to other business areas, such as cargo, hotel and car rental.

An effective cargo revenue management system accurately forecasts and deploys available supply, resulting in improved revenue and profit.

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Cargo Revenue Management Key Characteristics

Revenue management is a supply-and-demand optimization tool. Key characteristics of a business that would benefit from the application of revenue management techniques include:

- Offers perishable inventory/space,
- Serves different customers who are willing to pay different prices for the same product.

Airlines benefit from revenue management by selling space at a price that maximizes the revenue from various customers based on their willingness to pay, which varies depending on the product they buy from the airline.

Characteristics of the air cargo business such as these make it a prime candidate for revenue management:

- Cargo carried on passenger aircraft, making it difficult to know available cargo space.
- Different products are offered at different prices based on different customer requirements — same-day express shipping versus second-day shipping, for example.
- Booking behavior of customer in terms of under tending and over tendering, no shows and cancellations

An effective cargo revenue management system determines the available capacity on each flight, identifies the amount of each type of product that requires space on each flight and allocates capacities to the appropriate products in such a way as to maximize profit.

While using concepts similar to passenger revenue management, the cargo business process presents a more complex problem.

Understanding Price Segmentation

Figure 1 and Figure 2 at the right provide an illustration of price segmentation. Per Figure 1 on the previous page, let's assume that the carrying capacity for a flight is 100 tons and all cargo is sold at the same rate, $1.20 per kilogram (kg). Based on the price/demand for the flight, at most, 40 tons can be sold at this price resulting in revenue of $48,000.

Now, let's suppose you could charge three different rates for the same space (Figure 2). For the same price/demand at the rates of $1.65, $1.20 and $0.40 per kg., the demand that could be realized would be 17.5, 22.5 and 37.5 tons, respectively. So, by selling a portion of the capacity at a higher rate and the leftover capacity at a lower rate, the revenue for a price differentiation scheme is $70,875.

Conclusion: Applying revenue management to cargo can dramatically increase cargo revenues of a flight.

Glossary of Terms

Bid Price — The minimum amount that should be charged for a booking. Sometimes referred to as the inventory controls.

Capacity — The amount that can be carried by a aircraft, either by weight, volume or container positions.

Demand — Amount of anticipated cargo to be booked for a given flight/segment/O&D.

Overbooking — The practice of allowing more bookings than the carrying capacity of the flight in anticipation of a portion of the bookings canceling or not showing up at departure.

Oversales — What occurs when more cargo tenders at departure than the aircraft can hold.

Revenue management — The practice of maximizing revenues by charging different amounts for the same perishable product to different customers.

Show-up rate — The percent of bookings that will actually tender at departure.

Spoilage — The loss of revenue due to unused capacity.

Cargo Business Environment

The concepts used in cargo revenue management are similar to those deployed in passenger revenue management. However, differences in the cargo business process present a more complex problem, differences such as:

Uncertain capacities Cargo capacity changes with each departure whereas the number of seats for passengers is fixed.

Three-dimensional capacity All dimensions of cargo — including weight and volume, and container position (for widebody aircraft) — must be considered for each booking. In passenger revenue management, one passenger (regardless of dimensions) occupies one seat.

Cargo customers The number of cargo customers for a given airline may be few, yet they make large bookings. There are literally millions of passenger customers, and the behavior of one customer does not affect the entire flight.

Rate/density mix Determination of cargo bid pricing takes into account cargo rate and density. A passenger revenue management system uses only the rate or fare. Passengers are segmented by the fare structure, while cargo is segmented using rate and density.

Routing options Many more routing options for cargo can be considered within the service time window as compared to passengers.

System Capabilities

An effective cargo revenue management system accurately forecasts and deploys available supply, resulting in improved revenue and profit. The available supply and anticipated demand are matched in the system's optimization process to maximize the profits. This maximization can occur at the flight, segment or system-wide level.

Functions of a cargo revenue management system include:

Managing supply Forecasting and managing freight capacity, and overbooking.

Identifying and serving demand Generating demand forecasts while knowing the value of the demand type, in addition to recognizing the strategic importance of certain customers.

Combining supply and demand Determining the applicable bid price and ensuring that space is protected for high-value demand. The optimization process determines the correct rate/density mix, that is, the amount of cargo authorized for sale for each rate/density type. The authorized amounts are determined by the bid price, which is the minimum acceptable price for a booking.

As the amount of booked cargo increases, so does the bid price. Thus, as capacity is filled, the system enables high-end revenue bookings while shutting out lower revenue bookings from a flight.

Management of cargo contracts is essential to maximize cargo revenue.

Figure 1 Revenue without price differentiation

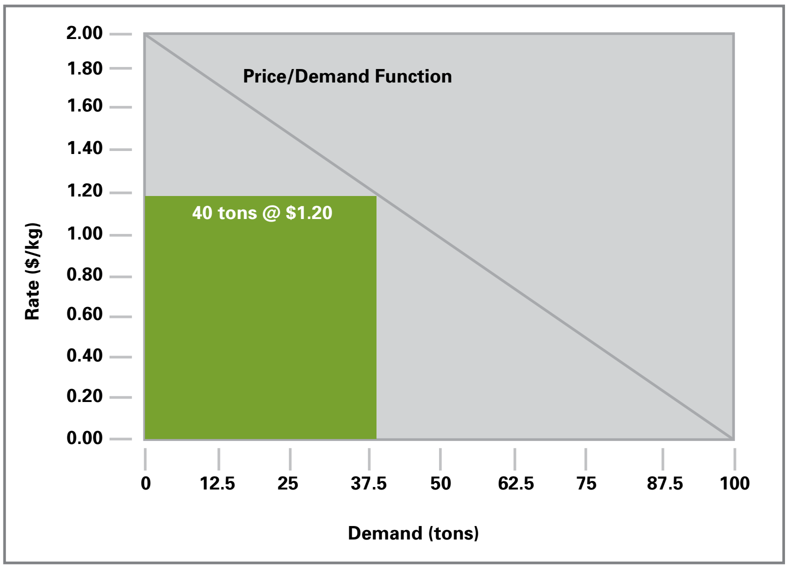
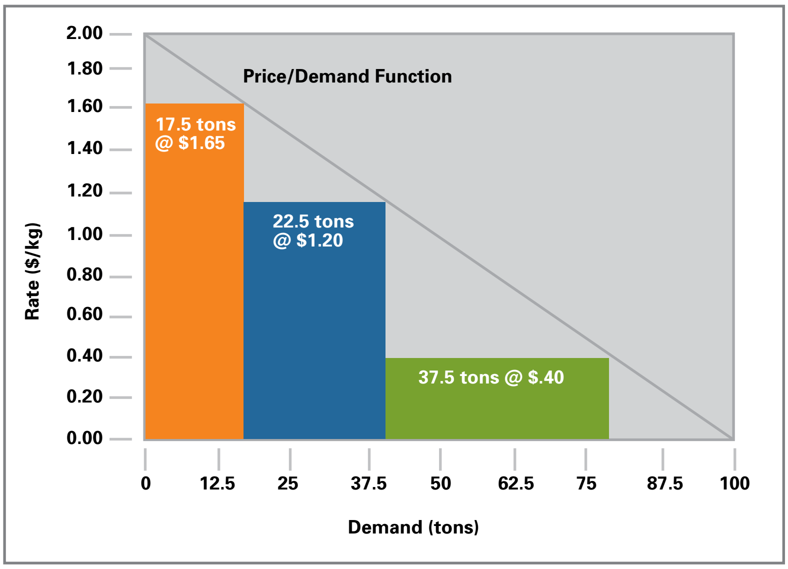


Figure 2 Revenue with price differentiation



Revenue Management Techniques

Capacity Forecasting

The first step in cargo revenue management is to estimate the available capacity on future flights. When determining capacity for cargo, both the weight and volume (or container positions, for a widebody aircraft) of the cargo must be considered. Since cargo revenue management centers around the space that is available for free sale, any space that is reserved for other materials must be excluded.

Impact On Available Space

The amount of space available for cargo is impacted by a number of factors. For example, if cargo is to be flown on an aircraft that is also carrying passengers, then the anticipated passenger load must be taken into account, since passengers have priority over cargo in most cases.

In addition, any anticipated increase in cargo for a flight will require an increase in fuel weight, resulting in less available space for cargo due to weight restrictions of the aircraft.

Other factors that effect cargo capacity include:

- Aircraft type,
- Passenger baggage weight,
- Extra fuel weight,
- Reserved space (allotments),
- Mail weight,
- Environmental (weather, time of year and so on).

Considering all of these factors when determining available capacity yields a more accurate result that can significantly improve revenue. Conversely, inaccurate capacity forecasting negatively affects cargo revenue.

For example, the forecasted capacity for a flight is 50 tons and all 50 tons is booked at departure. If the actual capacity for the flight is 60 tons — 10 tons more than forecasted — then the airline could have realized an increase in revenue associated with the sale of those 10 tons.

Revenue is also impacted if forecasted capacity is higher than actual available space. In this case, some cargo may be re-routed to another flight, incurring offload costs.

Overbooking

Overbooking is the practice of accepting more bookings than can be physically loaded into the carrying capacity of an aircraft. In overbooking, the assumption is made that a certain amount of booked cargo will not show up by flight departure. This may be due to a booking cancellation, cargo is not tendered for shipping or the amount of cargo tendered is only a portion of the total booking. The resulting unused space is known as spoilage.

How It Works

Overbooking enables an airline to compensate for revenue lost due to booking no-shows. A key element to appropriate overbooking is an accurate estimate of the bookings show-up rate. The show-up rate is the percent of bookings that will be tendered (total bookings minus spoilage).

For each flight, the show-up rate is forecasted based on historical behavior of the flight. With an accurate show-up rate, the overbooking level for a given flight can more confidently be set.

Figure 3 below depicts a booking profile using overbooking and without using overbooking. Choosing an appropriate overbooking level is vital to effective revenue management. An overbooking level set too low results in spoilage and missed revenue. An unreasonably high overbooking level promotes the sale of more space than is physically available (oversale), even after spoilage.

When oversales occur, revenue is decreased due to customer refunds, offload expenses, storage fees and loss-of-goodwill costs. The overbooking level can be defined as the booking level that corresponds to the lowest sum of spoilage costs and oversale costs (Figure 4 at right).

Allotment Management

An allotment — a long-term agreement between a customer or station and an airline — guarantees a specified amount of space on future flights. Because customers or stations may not use the allotted space, some airlines require that the space be released 48 hours before departure.

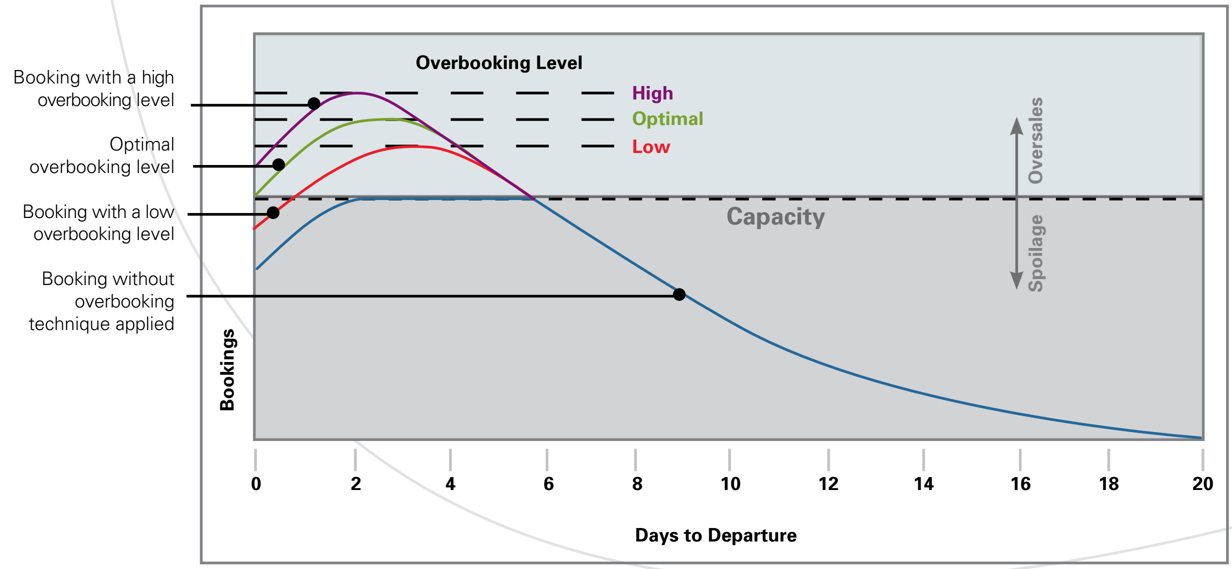


Figure 3 Booking profile with and without overbooking

This graph depicts bookings with different overbooking levels.

The gap between the black capacity line and blue line indicates the amount of unsold capacity resulting in loss of revenue.

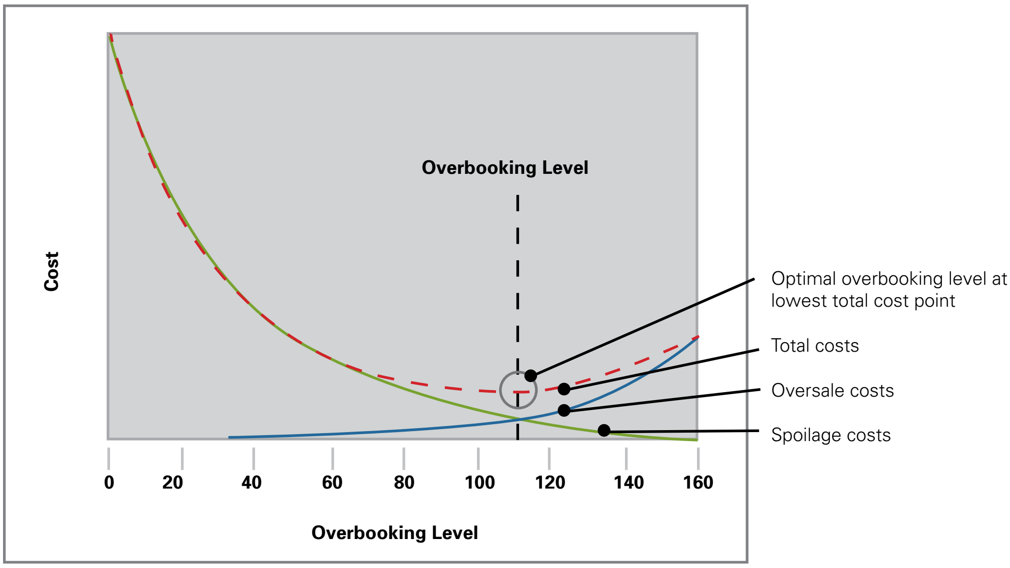
The red and violet lines represent overbooking conditions that can result in loss of revenue due to unsold capacity or offload charges.

Maximum revenue is achieved with an optimal overbooking level, as depicted by the green line.

Figure 4 Spoilage and offload costs versus load factor

This graph depicts the costs associated with setting up overbooking levels.

An optimal overbooking level can be determined by adding together the spoilage and oversale costs and identifying the point where total costs are the lowest.



When allotments are not used and the airline is not informed, flights could depart with unused capacity.

The Importance Of Management

Granting an allotment contract to a customer that consistently leaves allocated space unused drives up your spoilage costs. And although a long-term contract might be a low-risk revenue stream for an airline, if anticipated demand for the flight yields higher revenues than those sited in the contract, then accepting the contract costs money.

Diligent management of existing contracts and contract negotiations helps ensure improved revenue volume. By evaluating historical allotment behavior and determining the corresponding show-up rate, allocated space that is consistently left unused can be identified. By adding this space back into the capacity, it can be made available for free sale through the overbooking process.

Demand Forecasting

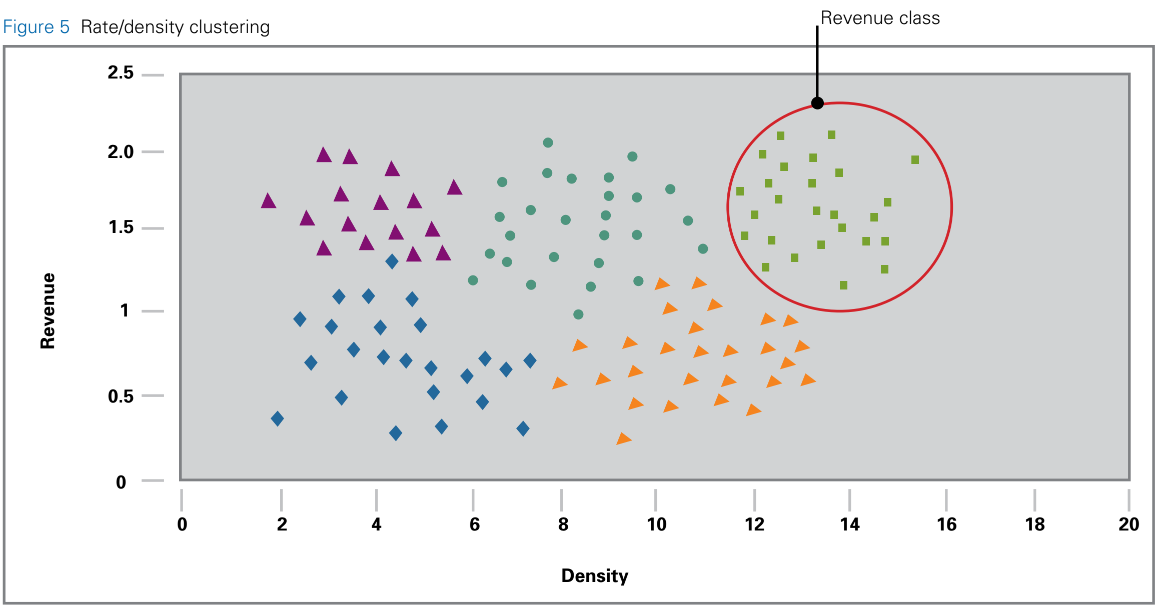
Demand forecasting determines how much cargo will tender for a particular flight.

How It Works

Demand is forecasted by revenue type, which is determined by the rate charged and the density of a shipment (rate/density type). Using historical data, sets of bookings are clustered together based on revenue and density, as in Figure 5 where density is defined in terms of cubic meter per ton.

This categorization enables forecasting and optimization to be performed by rate and load mix. A forecast is generated for each of these clusters, or revenue types, and for each flight, estimating the volume of each revenue type to be tendered at departure. The revenue management system's optimization function identifies the level of demand to be forecasted, so, for example, if optimization is performed at the O&D level, then demand must be forecasted at the O&D level.

Figure 5 Rate/density clustering



Bid price optimization results in an optimal rate and load mix per flight.

Bid Price Optimization

The bid price optimization function examines the demand for various types of capacity, as well as the level of demand, to arrive at the optimal bid price for each flight. It also determines the allocations of each revenue class for each flight.

The bid price for a flight represents the minimum amount that should be charged for the cargo and is proportional to the level of demand. When demand is low, resulting in spoilage, the bid price is low; and when demand is high, exceeding capacity, the bid price is high.

How It Works

Bid price optimization maximizes the profit of a group of flights by using demand forecasts and associated revenues, constrained by the capacities of the flights. The optimization process produces a bid price and a gradient for each flight leg.

Since the demand forecasts are based on revenue type, which includes density, the process constrains each flight according to its weight and volume capacities, resulting in an optimal rate and load mix per flight. An example of the bid price given the demand for a flight is shown in Figure 6. (For illustrative purposes, density is not used in this example.)

Assume there are four different revenue types defined by their respective rates (cost per kilogram): $2.00, $1.50, $1.00 and $0.50. The demand for these four types is three tons, six tons, 10 tons and 20 tons, respectively.

If the capacity for the flight is 15 tons, then the allocation would be three tons at $2, six tons at $1.50 and six tons at $1.00. No bookings would be accepted for the $0.50 rate. The initial bid price for the flight would be $1.00 per kilogram.

If the capacity for the flight capacity was 25 tons, then the allocation would be three tons at $2, six tons at $1.50, 10 tons at $1.00 and six tons at $0.50. Only six tons would be accepted out of 20 tons possible for the $0.50 rate.

The initial bid price for the flight would be $0.50 per kilogram.

Figure 6 Bid price example

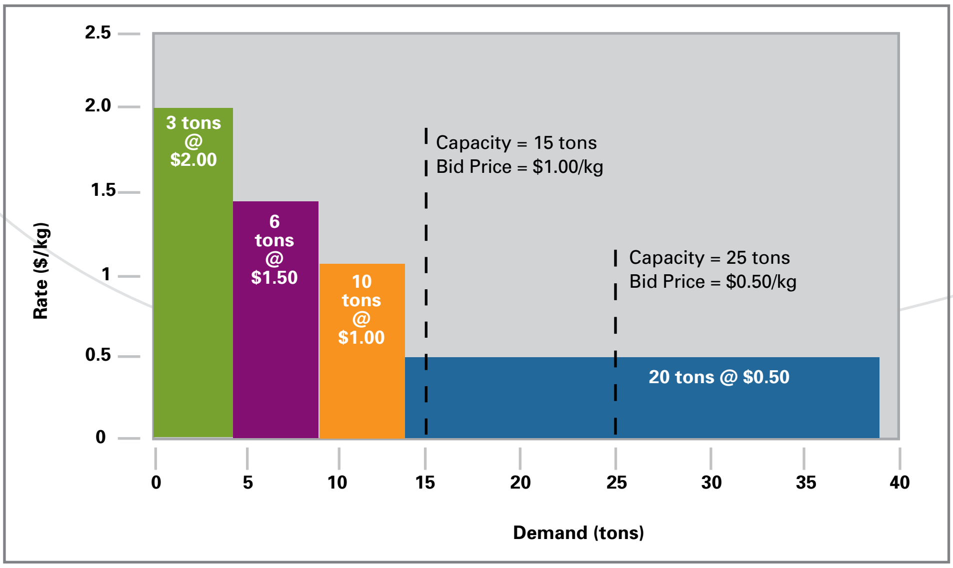
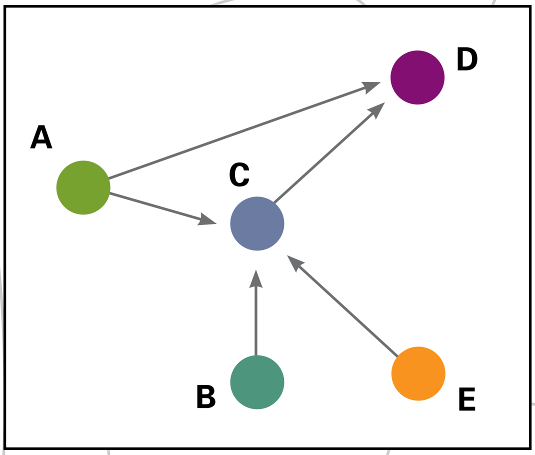


Figure 7 Sample flight network



Optimization Options

A revenue management system can control flights at various levels — flight leg, segment or O&D. Determining which level to employ is based on several criteria, such as:

- Flight network structure — hub-and-spoke versus point-to-point,
- Customer behavior — local versus flow (multi-leg) shipments,
- Data availability,
- Computing capacity.

Figure 7 illustrates the differences between leg, segment and O&D optimization. The letters A, B, C, D and E represent cities. For simplicity, the flight legs are unidirectional: AD, AC, BC, EC and CD.

Leg-Based Optimization

Leg-based optimization computes the inventory controls for each leg separately. No impact from the other flight legs is taken into account.

How It Works

Leg-based optimization works best when the number of multi-leg shipments is insignificant. That is to say, the occurrence of high-revenue, multi-leg shipments displacing single-leg (local) shipments is minimal.

When employing leg-based optimization, flights are optimized separately, and all traffic is assumed to be local. Thus (referring to Figure 7), if a shipment on flight BC continues on flight CD, it is treated as two different shipments during the optimization process.

Segment-Based Optimization

Segment-based optimization computes inventory controls for each segment — all flight legs containing the same flight number, taken together. In addition, segment-based optimization considers shipments that are shipped on a flight that uses multiple legs.

How It Works

Segment-based optimization works well for a flight network with multi-leg shipments originating at a hub. Looking again at Figure 7, let's assume that flights BC and CD have the same flight number. The flight segment, then, contains these two legs and is designated as BCD.

A shipment booked on BC and CD (segment BCD), will be included in segment-based optimization. The bid prices for the flight legs will be influenced by demand with multi-leg itineraries, where the multiple legs are from the same flight number.

The optimization will be over all of the segments — whereas in leg-based optimization, the demand on segment BCD was treated as two local demands, that is, counted as both BC and CD demand.

Revenue management enables airlines to sell space at a price that maximizes the revenue from various customers based on their willingness to pay.

Table 1 O&D component legs

Orgin & Destination	Available Paths
AC	AC
AC	AC
AD	AD AC-CD
EC	EC
ED	EC-CD
BD	BC-CD

O&D Optimization

O&D optimization computes bid prices based on where the demand starts (origin) and where it ends (destination), regardless of the number of flight legs involved. However, in order to take advantage of O&D optimization, the demand data must be available at the O&D level. O&D optimization takes into account all O&D combinations and the conflicts associated with flights flying over common legs to different destinations.

How It Works

O&D optimization is preferred for hub-and-spoke systems with many multi-leg shipments. An O&D can have different paths — AD is an O&D, but a shipment can get from A to D by the direct flight (AD) or the two-leg itinerary (AC and CD). Table 1 shows the flights that comprise each O&D.

O&D optimization maximizes the profit for the entire system — it displaces demand in a local (single leg) market with flow demand (multiple leg) if the displacement results in higher profits. For example, if demand from E to D is forecasted but the revenue from the EC leg of the O&D is lower than a local (EC) shipment, then this demand would not be allocated using leg-based optimization.

However, with O&D optimization, if the O&D revenue is greater than the sum of the local traffic revenue from EC and CD, then the ED demand will be given preference. To compute the bid prices for a system, O&D optimization evaluates all local and flow traffic that is competing for space on a flight.

Conclusion

Revenue management practices help increase revenues for a variety of companies in many different industries, including airline passenger sales, air cargo and hotels. Characteristics of the air cargo business — perishable commodities, demand that does not always show up and customers willing to pay different prices for the same commodity — make it a prime candidate for revenue management techniques.

Given these characteristics, an air cargo business can take advantage of revenue management functions. These functions include allotment management and overbooking to help reduce spoilage, as well as demand segmentation and bid price optimization, which differentiate between high-revenue and low-revenue demand and allocate inventory appropriately.

An effective revenue management system improves the profits on flights and increases the productivity level of the analyst responsible for managing the flights. The system frees the analyst to concentrate on critical flights (high revenue, highly competitive flights) and also provides decision-support information for intelligent decision making.

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