Outline

- Concept
- Example
- Components
  - Real-Time Transaction Processing
  - Extracting, Transforming, and Loading Data
  - Forecasting
  - Optimization
  - Decision Support
- Non-Traditional Applications
- Further Reading and Special Interest Groups
Revenue Management and Dynamic Pricing

Revenue Management in Concept
What is Revenue Management?

- Began in the airline industry
  - Seats on an aircraft divided into different products based on different restrictions
    - $1000 Y class product: can be purchased at any time, no restrictions, fully refundable
    - $200 Q class product: Requires 3 week advanced purchase, Saturday night stay, penalties for changing ticket after purchase
What is Revenue Management?

Revenue Management:
- The science of maximizing profits through market demand forecasting and the mathematical optimization of pricing and inventory

Related names:
- Yield Management (original)
- Revenue Optimization
- Demand Management
- Demand Chain Management
Rudiments

- **Strategic / Tactical: Marketing**
  - Market segmentation
  - Product definition
  - Pricing framework
  - Distribution strategy

- **Operational: Revenue Management**
  - Forecasting demand by willingness-to-pay
  - Dynamic changes to price and available inventory
Industry Popularity

- Was born of a business problem and speaks to a business problem
- Addresses the revenue side of the equation, not the cost side
  - 2 – 10% revenue improvements common
### Industry Accolades

<table>
<thead>
<tr>
<th><strong>THE WALL STREET JOURNAL</strong></th>
<th><strong>Houston Chronicle</strong></th>
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</thead>
<tbody>
<tr>
<td>“Now we can be a lot smarter. Revenue management is all of our profit, and more.”</td>
<td>“PROS products have been a key factor in Southwest's profit performance.”</td>
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<tr>
<td><strong>Bill Brunger, Vice President Continental Airlines</strong></td>
<td><strong>Keith Taylor, Vice President Southwest Airlines</strong></td>
</tr>
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</table>
“Revenue Pricing Optimization represent the next wave of software as companies seek to leverage their ERP and CRM solutions.”
– Scott Phillips, Merrill Lynch

“One of the most exciting inevitabilities ahead is ‘yield management.’
– Bob Austrian, Banc of America Securities

“Revenue Optimization will become a competitive strategy in nearly all industries.”
– AMR Research
As we move into a new millennium, dynamic pricing has become the rule. “Yield management,” says Mr. Varian, “is where it’s at.”

“To Hal Varian the Price is Always Right,” *strategy+business*, Q1 2000.

Dr. Varian is Dean of the School of Information Management and Systems at UC Berkeley, and was recently named one of the 25 most influential people in eBusiness by Business Week (May 14, 2001)
Application Areas

**Traditional**
- Airline
- Hotel
- Extended Stay Hotel
- Car Rental
- Rail
- Tour Operators
- Cargo
- Cruise

**Non-Traditional**
- Energy
- Broadcast
- Healthcare
- Manufacturing
- Apparel
- Restaurants
- Golf
- More…
Revenue Management and Dynamic Pricing

Managing Airline Inventory
Airline Inventory

- A mid-size carrier might have 1000 daily departures with an average of 200 seats per flight leg
Airline Inventory

- 200 seats per flight leg
  - $200 \times 1000 = 200,000$ seats per network day
- 365 network days maintained in inventory
  - $365 \times 200,000 = 73$ million seats in inventory at any given time
- The mechanics of managing final inventory represents a challenge simply due to volume
Airline Inventory

- Revenue management provides analytical capabilities that drive revenue maximizing decisions on what inventory should be sold and at what price
  - Forecasting to determine demand and its willingness-to-pay
  - Establishing an optimal mix of fare products
Should a $1200 SEA-IAH-ATL M class itinerary be available? A $2000 Y class itinerary?
Fare Product Mix

Should a $600 IAH-ATL-EWR B class itinerary be available? An $800 M class itinerary?
Fare Product Mix

- Optimization puts in place inventory controls that allow the highest paying collection of customers to be chosen.
- When it makes economic sense, fare classes will be closed so as to save room for higher paying customers that are yet to come.
Revenue Management and Dynamic Pricing

Components
The Real-Time Transaction Processor

Real Time Transaction Processor
(RES System)

Requests for Inventory
The Revenue Management System

- Extract, Transform, and Load Transaction Data
- Forecasting
- Optimization

Revenue Management System

Real Time Transaction Processor (RES System)

Requests for Inventory
Analysts

Analyst Decision Support

Extract, Transform, and Load Transaction Data
Forecasting
Optimization

Revenue Management System

Real Time Transaction Processor (RES System)

Requests for Inventory
The Revenue Management Process

Analyst Decision Support

- Extract, Transform, and Load Transaction Data
- Forecasting
- Optimization

Revenue Management System

Real Time Transaction Processor (RES System)

Requests for Inventory
Real-Time Transaction Processor

- The optimization parameters required by the real-time transaction processor and supplied by the revenue management system constitute the inventory control mechanism.
DFW-EWR: $1000 Y  $650 M  $450 B  $300 Q
Nested leg/class availability is the predominant inventory control mechanism in the airline industry.
A fare class must be open on both flight legs if the fare class is to be open on the two-leg itinerary.
Real-Time Transaction Processor

- While there are many potential inventory control mechanisms other than leg/class control, two have come to predominate revenue management applications
  - Virtual nesting
  - Bid price
Real-Time Transaction Processor

SAT-DFW-EWR M class is available
SAT-DFW M class is available
DFW-EWR M class is closed
Real-Time Transaction Processor

Bid Price = $100

Bid Price = $700

- $900 SAT-DFW-EWR M class is available
- $300 SAT-DFW M class is available
- $650 DFW-EWR M class is closed
Inventory control: A primal versus dual debate

- Virtual Nesting
  - Primal control establishing (virtual) inventory levels
- Bid Price
  - Dual control establishing prices or opportunity costs for units of inventory
Extract, Transform, and Load Transaction Data

- Complications
  - Volume
  - Performance requirements
  - New products
  - Modified products
  - Purchase modifications
Extract, Transform, and Load Transaction Data

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   PSG 01 OA 2297 MYR IAH Q 010903 1140 010903 1255 010903 1350 010903 1655 HK OA 0 0
Demand Models and Forecasting

- How should demand be modeled and forecast?
  - Small numbers / level of detail
  - Unobserved demand and unconstraining
  - Elements of demand: purchases, cancellations, no shows, go shows
  - Demand model ... the process by which consumers make product decisions
  - Demand correlation and distributional assumptions
  - Seasonality
Demand Models and Forecasting

- Holidays and recurring events
- Special events
- Promotions and major price initiatives
- Competitive actions
Optimization

- Optimization issues
  - Convertible inventory
  - Movable inventory / capacity modifications
  - Overbooking / oversale of physical inventory
  - Upgrade / upward substitutable inventory
  - Product mix / competition for resources / network effects
## Decision Support

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<tr>
<td><strong>Compartment</strong></td>
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<tr>
<td>Total</td>
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</tr>
</tbody>
</table>

### Class & Type

| Class | Fare | Type | Bkd | Ekd | Dmd | Cur | New | Protect | Sts | Gate | DC | New | Ob+Dc | Mult | New | Nst Mode | New | Sts Avail | New | 
|-------|------|------|-----|-----|-----|-----|-----|---------|-----|------|----|-----|-------|------|-----|----------|-----|----------|-----|----------|
| J     | 076  | 3    | 0   | 0   | 3   | 3   | 0   | 0       | 100 | 100  | 100| 0   | 100   | 100  | 0   | -       | 13  | 0        |
| C     | 608  | 6    | 0   | 20  | 12  | 6   | 0   | 0       | 109 | 100  | 100| P   | P     | 15   | 0   | 0        |
| D     | 559  | 0    | 3   | 7   | 0   | 0   | 0   | 0       | 100 | 100  | 100| P   | P     | 7    | 0   | 0        |
| Z     | 146  | 0    | 0   | 0   | 0   | 0   | 0   | 0       | 100 | 100  | 100| P   | P     | 0    | 0   | 0        |
| I C   | 0    | 0    | 0   | 10  | 10  | 0   | 0   | 0       | 100 | 200  | -   | -   | 10    | 20   |    |          |
| Y     | 819  | 0    | 0   | 3   | 2   | 0   | 0   | 0       | 100 | 113  | -   | -   | 5     | 0    |    |          |
| M     | 505  | 0    | 0   | 1   | 1   | 0   | 0   | 0       | 100 | 110  | -   | -   | 3     | 0    |    |          |
| L     | 375  | 0    | 0   | 4   | 2   | 0   | 0   | 0       | 100 | 103  | -   | -   | 2     | 0    |    |          |
| H     | 320  | 2    | 0   | 5   | 0   | 2   | 0   | 0       | 100 | 103  | -   | -   | 2     | 0    |    |          |
| K     | 313  | 11   | 0   | 24  | 6   | 10  | 0   | 0       | 122 | 109  | -   | -   | 4     | 0    |    |          |
| G G   | 293  | 22   | 22  | 22  | 22  | 22  | 0   | 0       | 100 | 100  | A   | A   | -3    | 0    |    |          |
| B     | 215  | 41   | 0   | 68  | 25  | 37  | 0   | 0       | 113 | 108  | P   | P   | -13   | -1   |    |          |
| V Z   | 106  | 0    | 0   | 0   | 0   | 0   | 0   | 0       | 100 | 100  | P   | P   | -11   | -1   |    |          |
| X C   | 0    | 0    | 0   | 10  | 10  | 0   | 0   | 0       | 100 | 400  | -   | -   | 10    | 40   |    |          |

### Booking Curves

**Business:**
- **CAP:** 13
- **AU:** 0

**Economy:**
- **CAP:** 100
- **AU:** 0
Revenue Management and Dynamic Pricing

Non-Traditional Applications
Two Non-Traditional Applications

- Broadcast
  - Business processes surrounding the purchase and fulfillment of advertising time require modification of traditional revenue management models

- Healthcare
  - Business processes surrounding patient admissions require re-conceptualization of the revenue management process
New Areas

- Contracts and long term commitments of inventory
- Customer level revenue management
- Integrating sales and inventory management
- Alliances and cooperative agreements
- Block inventory valuation
Revenue Management and Dynamic Pricing

Further Reading and Special Interest Groups
Further Reading

- For an entry point into traditional revenue management
Special Interest Groups

- INFORMS Revenue Management Section
  - www.rev-man.com/Pages/MAIN.htm
  - Annual meeting held in June at Columbia University

- AGIFORS Reservations and Yield Management Study Group
  - www.agifors.org
  - Follow link to Study Groups
  - Annual meeting held in the Spring
Revenue Management and Dynamic Pricing

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