

Revenue Management Techniques for Road Pricing

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- PhD in OR at Erasmus University Rotterdam:
“Revenue Management: New Features & Models”
- RM specialist at ORTEC since 2005
- ORTEC is market leader in RM
- RM customers include:



- One of the largest providers of OR solutions worldwide
- Consultancy & Software
- 700 employees / 1000 customers
- Offices in Europe & North America

Supply Chain Optimization • Risk Management
Workforce Scheduling • Route Optimization
Production Planning • Revenue Management

...

- Optimizing de-icing routes
- Accounting for traffic in logistic decision making
- Response time optimization for traffic incidents
- Road Pricing

- Fairness
- Technical implementation
- Costs of implementation
- Environmental effects
- Effects on public transport
- ...
- How to determine price levels?

- What is RM?
- Road Pricing vs. RM
- What Road Pricing can learn from RM
- Conclusions and questions

Using price and availability to manage demand
such that revenues are maximized

Often used when facing:

- Fixed capacity
- Perishable capacity (deadline)
- Sunk costs

Airline Company:

Remaining capacity: 100 seats

Remaining time: 10 weeks

Expected sales rate: 6 seats per week

→ Lower the price?

Sell your product in NL for €100 and in Belgium for €125:

Remaining capacity: 60

Remaining time: 5 weeks

Expected sales rate: 10 per week in Belgium
5 per week in NL

→ Limit availability in NL to 10?

Hotel

Wednesday & Saturday have different prices

☐ ma	17	72,50	72,50
☐ di	18	72,50	72,50
☐ wo	19	72,50	72,50
☐ th	20	72,50	72,50

Airline

10 different prices within Economy Class



Tour Operator

Daily price changes (last minutes)



The use of statistical & OR models has lead to enormous performance improvements and the growing importance of RM

- Objective decision making based on actual data
- Take into account more data and complexity

- Maximize revenues
- Fixed capacity
- Perishable capacity
- Sunk costs
- Fluctuating demand
- Advance reservations
- Product differentiation
- Price based control
- Availability based control

Minimize traffic jams

✓

✓

✓

✓

-

✓

✓

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- Data collection
- Product differentiation
- Demand forecasting
- Price optimization
- Communication
- Evaluation

- Time of day
- Day of week
- Transport type
- Road classification

A: expensive, B: normal, C: cheap

- Data collection
- Product differentiation
- Demand forecasting
- Price optimization
- Communication
- Evaluation

- Unit of demand
- Influences on demand
 - daily patterns, seasonal patterns, weather forecast, ...
- Price elasticity !
- Cross-correlations
- Point estimate vs. distribution function

- Data collection
- Product differentiation
- Demand forecasting
- Price optimization
- Communication
- Evaluation

RM: Set the price such that revenues are maximized

RP: Set the price such that traffic jams are minimized

Difficulties:

- Demand uncertainty

Stochastic optimization

- Network effects (displacement)

Combinatorial optimization

Deterministic approach:

Set the price such that on average there is no traffic jam

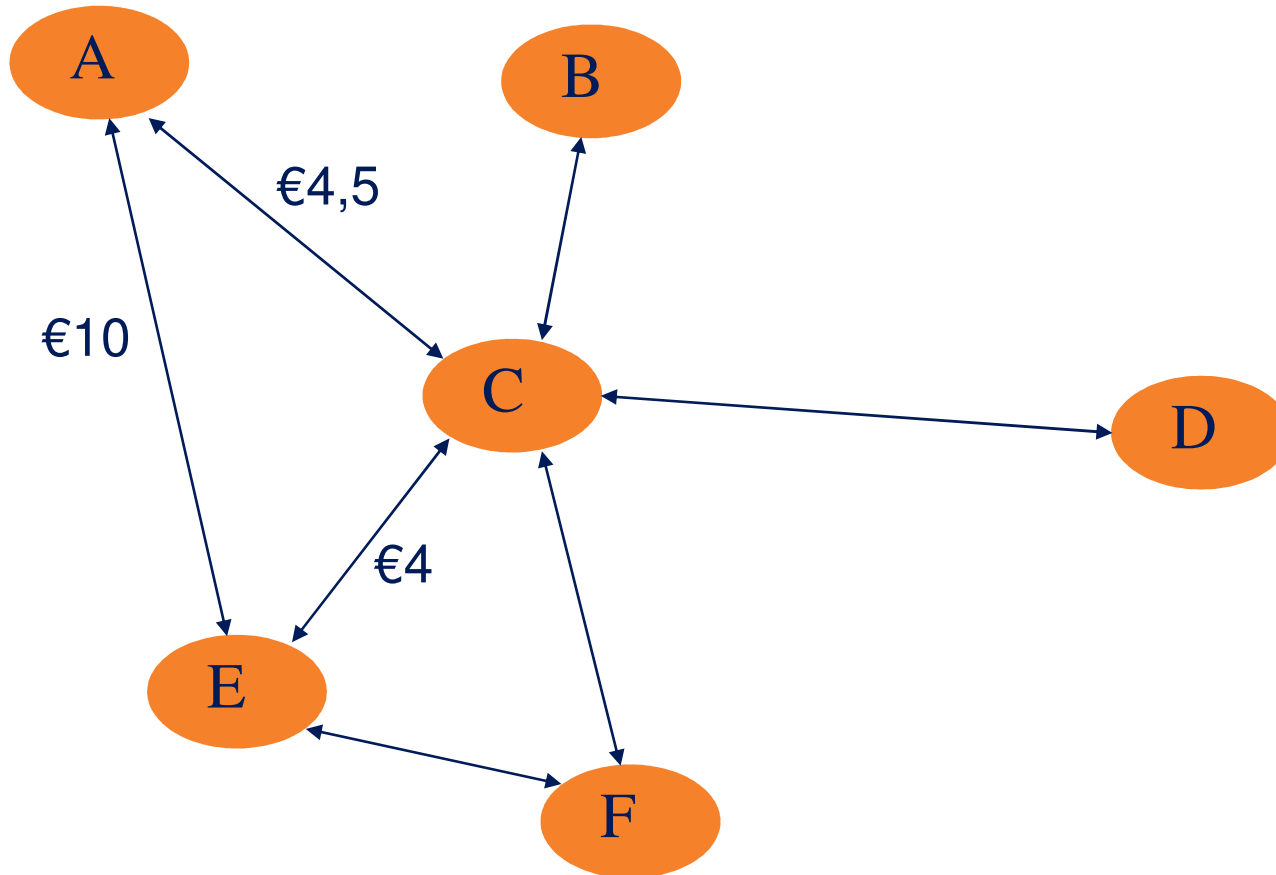
$$\textit{expected demand} \leq \textit{capacity}$$

Stochastic approach:

Set the price such that the probability of a traffic jam is sufficiently small

$$\textit{Prob}(\textit{demand} \geq \textit{capacity}) \leq \alpha$$

trade-off between price & probability



- Data collection
- Product differentiation
- Demand forecasting
- Price optimization
- Communication
- Evaluation

- Many similarities between RM & Road Pricing
 - Price based demand management
 - Fixed and perishable capacity
 - Demand uncertainty (price elasticity, cross-correlations)
 - Network effects (displacement)
- Also differences between RM & Road Pricing
 - Revenue maximization vs. traffic jam minimization
 - Dynamic vs. static control
- A shame not to use available RM knowledge!

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