TECHNISCHE UNIVERSITÄT DRESDEN

DRESDEN concept

Capacity and Revenue Management for Transport Services

Chapter 1
Demand-Oriented Pricing of Mobility Services

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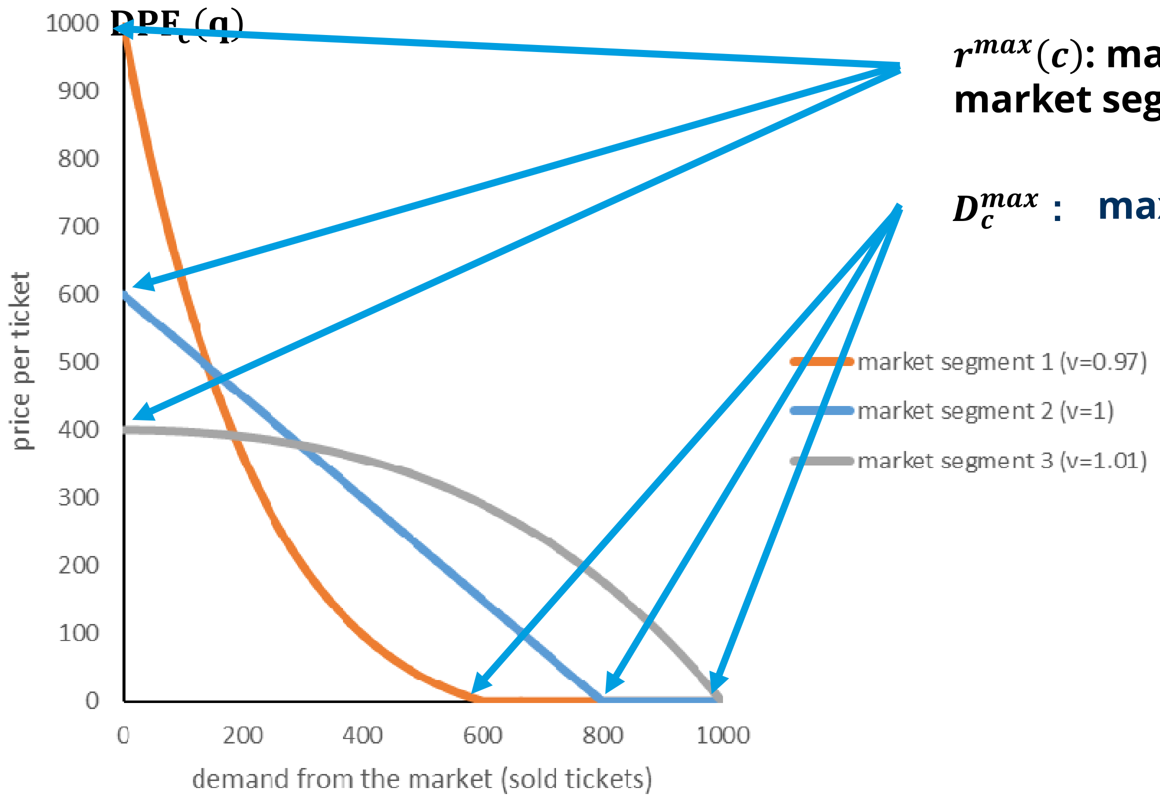
Chapter Agenda

- What is Pricing? – A Short Survey
- Introduction to the FORTE Case
- FORTE: Challenges in Pricing
- Derivation of a Teaching Agenda

What is Pricing?

- **Pricing comprises methods and tools to determine the selling price (amount of money received from the buyer) for material products and services**
- **Determinants of pricing**
  - *Company objectives and product positioning*
  - *Existing cooperations, strength of competition, market*
  - *Costs (for providing the considered product/service)*
- **Generic Pricing concepts**
  - *Cost-Plus Pricing ⇒ price = costs + margin contribution*
  - *Market-Based Pricing ⇒ price = price we found in the existing market*
  - ***Demand-based Pricing / Value Pricing ⇒ we try to find out the individual maximal willingness to pay for each market***

Demand Price Function – Coupling Price and Allocated Capacity



$r^{max}(c)$: maximal possible price with demand ≥0 in market segment c

D_c^{max} : maximal demand from segment c

Discrete Demand Price Function

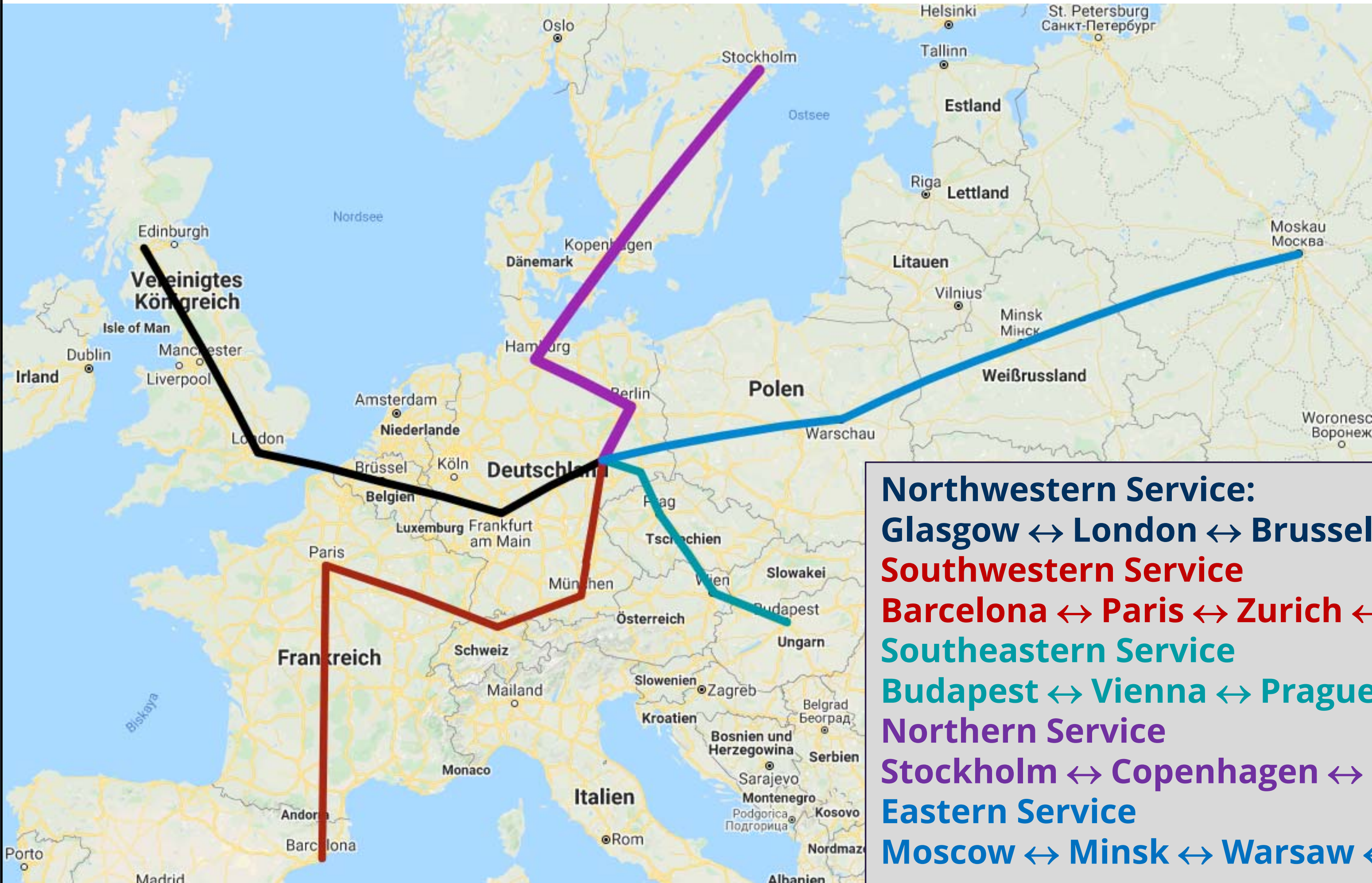
$$DPF_c(q) = \left(\frac{r^{max}(c) - 0}{0 - D_c^{max}} \cdot q + r^{max}(c) \right) \cdot F_v(q)$$

$$F_v(q) = \begin{cases} 1, & q = 0 \\ F_v(q-1) \cdot v^{\frac{q}{10}} & q = 1, \dots, D_c^{max} \\ 0 & q > D_c^{max} \end{cases}$$

The Optimization Problem Behind Pricing

- **Optimal pricing for the three market segment requires 1210 available tickets**
- **What happens if only 1000 tickets are available? ⇒ constrained optimization task!**

The FORTE Railservice Network



Northwestern Service:
Glasgow ↔ London ↔ Brussels ↔ Frankfurt ↔ Leipzig
Southwestern Service
Barcelona ↔ Paris ↔ Zurich ↔ Munich ↔ Leipzig
Southeastern Service
Budapest ↔ Vienna ↔ Prague ↔ Dresden ↔ Leipzig
Northern Service
Stockholm ↔ Copenhagen ↔ Hamburg ↔ Berlin ↔ Leipzig
Eastern Service
Moscow ↔ Minsk ↔ Warsaw ↔ Leipzig

Operational Details

- **Five different services („lines“) in a star-shaped network**
  - *Operating one train service on each line per day and direction*
  - *Central hub in Leipzig (Germany)*
  - *A service in each direction lasts approx. 20 hours from terminus to terminus*
- **Variable train configurations**
  - *Two engines (at each end of a train) and up to eight wagons allowed*
  - *Train re-composition easily possible at each terminus of a line during the turn-around-phase*
  - *Three types of wagons*
    - Economy class for budget travellers
    - Business class for passengers with high willligness to pay
    - Freight carriage wagon

FORTE case – Challenges in Pricing

- Q1. How many seats should we offer in Economy as well as Business Class on each service to maximize revenues?
- Q2. How many wagons should be purchased (of each type)?
- Q3. What are the optimal prices for tickets for each service and for each class as well as freight?
- Q4. How can we avoid that business customers book in Economy Class instead of Business Class and vice versa?
- Q5. How can we react if the prices we have set turn out to be too high or too low?
- Q6. Is it possible to sell tickets at different prices for the same service? If this is possible, how can we ensure that we earn the maximal money from the market?

Market Segmentation

- **Splitting up a heterogeneous market M (group of sellers) into a collection of non-overlapping subsets $M_1,\dots,M_n$ („segments")**
  - *each segment is non-empty*
  - *all members of a segment exhibit an identical behavior*
- **Product differentiation**
  - *clear definition of different products / services to be sold*
  - *identification of involved resources needed to provide the service*
  - *several products might compete for scarce resources*
  - *FORTE case: differentiation between Tickets for a ride in Economy Class and Business Class wagons*
- **Price discrimination**
  - *given a product P to be sold*
  - *assign an individual price p_i for this product P to each segment i $\Rightarrow$ "price differentiation"*
  - *need to avoid self-induced segment change of customers $\Rightarrow$ definition of „fences"*
  - *FORTE case: special fare with discounts for early bookings vs. regular fare for late bookings*

Proactive vs. Reactive Pricing

- **When do we decide for the price for the next unit to be sold of a product?**
- **Proactive pricing**
  - *a priori to upcoming demand from the market*
  - *once a price is fixed it will not be changed anymore*
  - *suitable demand forecast is needed*
  - *in the FORTE case: assignment of a static ticket price for a ride on a service*
- **Reactive pricing**
  - *price adopts to recently observed market demand*
  - *several price updates within the selling period possible*
  - *requirement: insights into market evolution*
  - *in the FORTE case: modification of the ticket price after unexpected demand has been detected on a particular service*

Derivation of Four Generic Pricing Scenarios

		Control of Market Demand	
		we can partition the complete market demand	no clear market segmentation possible
How do we determine prices for a product?	a priori pricing		
	re-active pricing		

Summary of this Chapter

- **We have learned, …**
  - *… the meaning of the term „pricing“*
  - *… typical pricing challenges outlined in the FORTE case description*
- **Next, …**
  - *… we are going to discover typical example for the four derived pricing scenarios*
  - *… we introduce state-of-the-art approaches and tools to determine “best” prices*