Oleg S. Melnikov
Department of System Analysis and Information-Analytical Technologies
National Technical University “Kharkiv Polytechnic Institute”

Dynamic Pricing Strategies

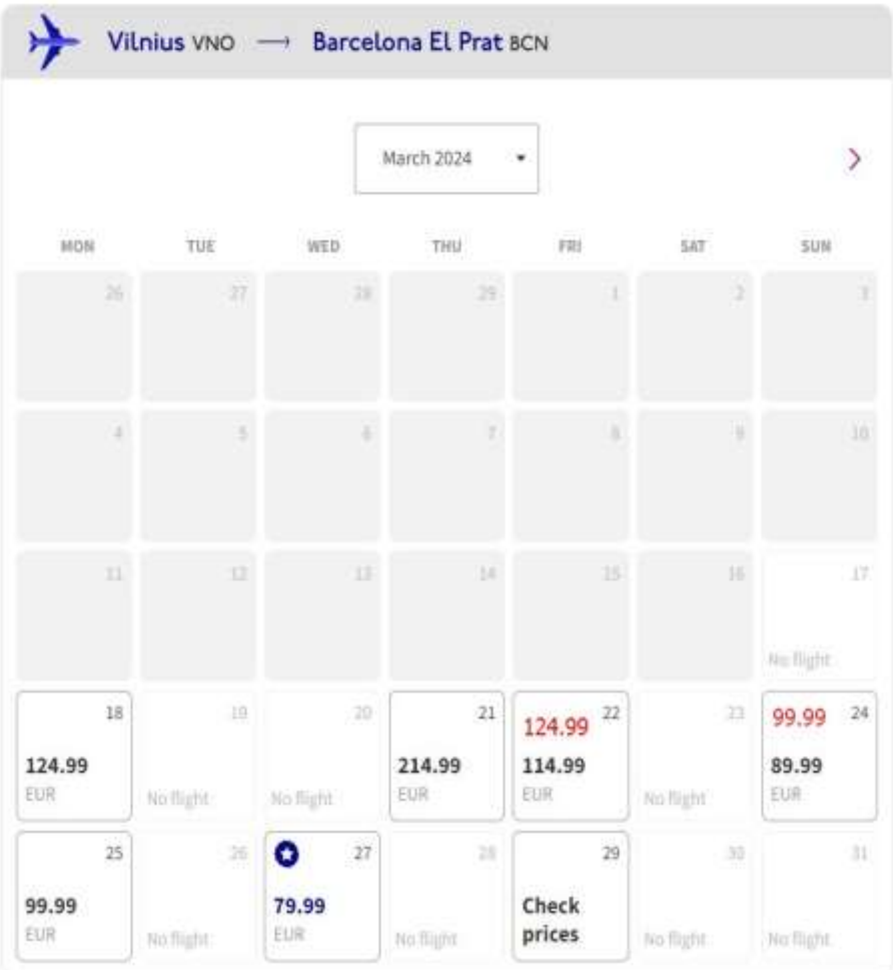
Outline

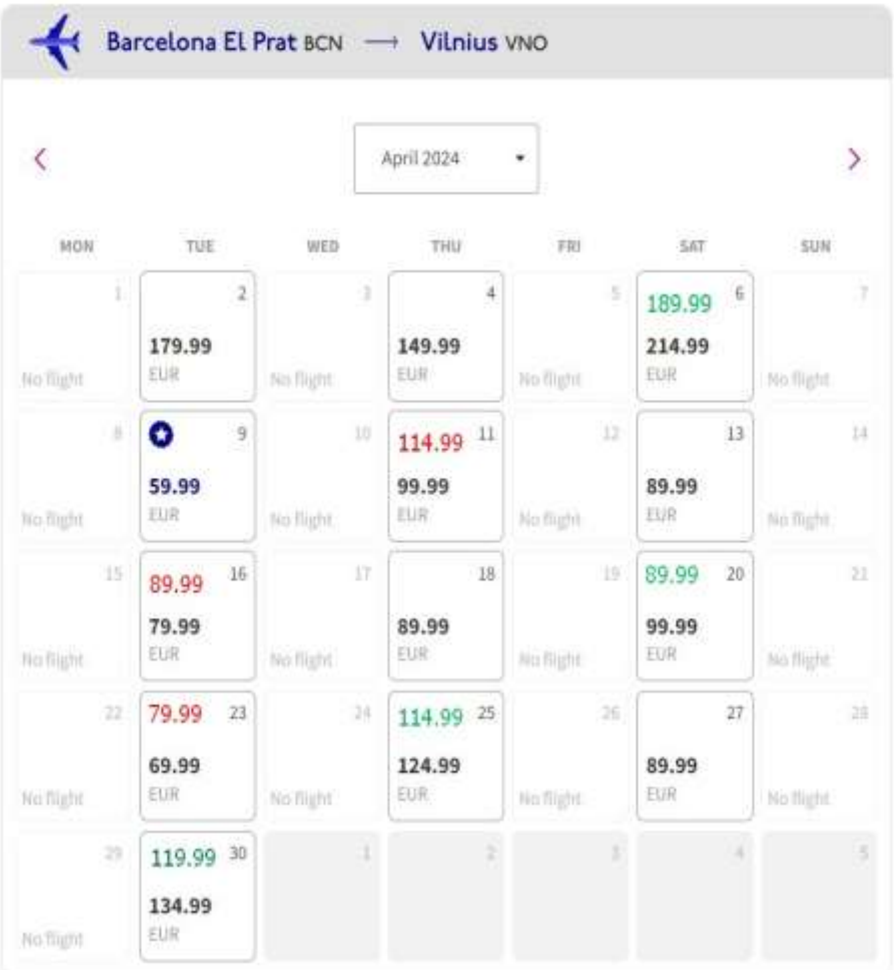
1. What is Dynamic Pricing?
2. Examples of Dynamic Pricing
3. History of Dynamic Pricing
4. Dynamic Pricing as a Form of Price Discrimination
5. Where Dynamic Pricing Can Be Used
6. Types of Dynamic Pricing
7. Peak-Load Pricing
8. Inventory Based Dynamic Pricing
9. Algorithmic Pricing, Machine Learning, etc.

What is Dynamic Pricing?

- *Dynamic pricing* is a pricing strategy in which businesses set flexible, potentially different prices for products or services in different time periods.
- Businesses change prices based on such factors as competitor pricing, demand fluctuations, supply conditions, etc.
- Actually, the ability of prices to adapt to changing environment is the main element of the market mechanism. However, the frequency of price adjustments commonly is relatively low (months, years).
- Factors that work against frequent price changes:
  - lack of operational information
  - time required to realize the changes that have taken place
  - high costs associated with price changes
- Price increases due to poor harvest, logistic disruptions etc. are also not considered as dynamic pricing
- Dynamic pricing takes place when:
  1) Price changes are frequent
  2) Price can change both ways

Example: Wizzair Vilnius-Barcelona flight prices (sampled on 17.03 & 18.03.24)





History of Dynamic Pricing, Part I

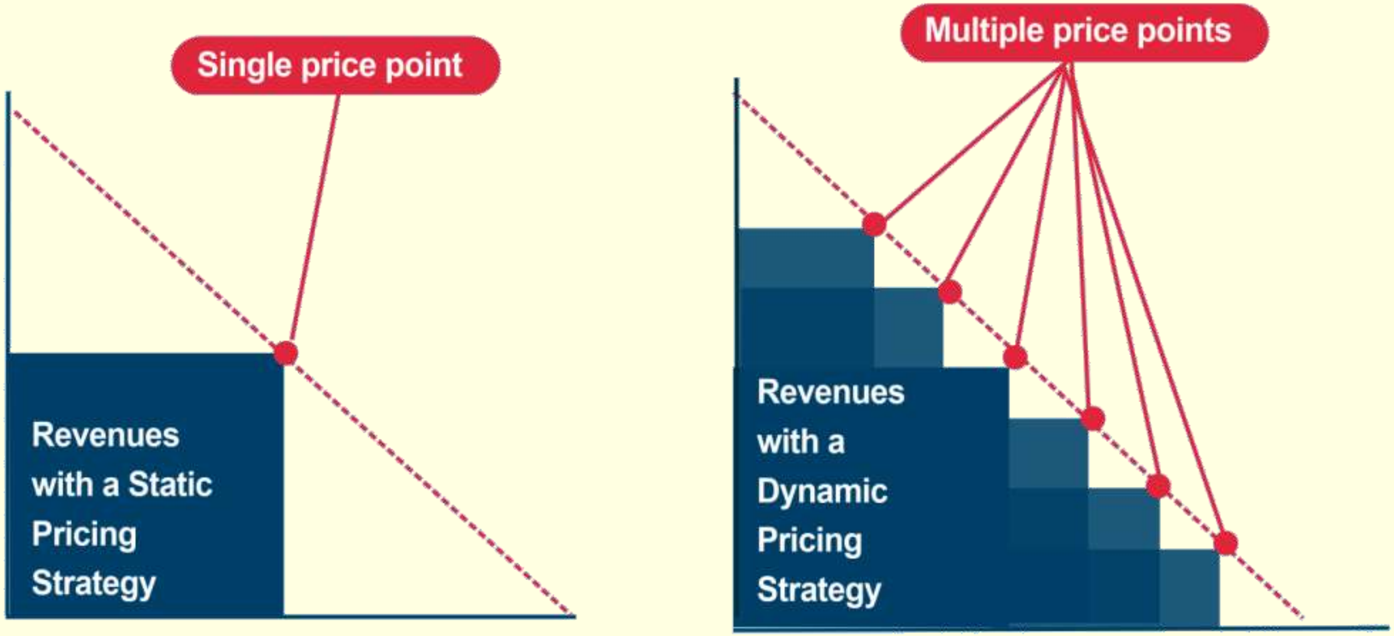
- Dynamic pricing has been the norm for most of human history
- Traditionally buyer and seller would negotiate a price for a product based on their bargaining skills, stock levels, time of the day, etc.
- This price haggling process is time-consuming and requires experienced, highly skilled salesmen
- As retail expanded during the Industrial Revolution, assortments and the number of stores grew. The negotiation model quickly proved inefficient within an economy of scale. Invention of the price tag (1870s, Macy’s) eliminated haggling and allowed shorter training time and less experience for shop clerks.
- Another dimension is ethical issues associated with selling the same product at different prices to different consumers. US puritans in particular viewed this practice as immoral
- Thus, dynamic pricing largely disappeared during XX century

History of Dynamic Pricing, Part II

- Reemergence in 1990s, largely driven by technological innovation (e-commerce, management information systems, program trading etc.)
- Facilitating factors:
  - low cost of changing prices in e-commerce
  - availability of large volumes of data on demand in real time
  - integrating complex price adjustment algorithms directly into the general software environment of the online store.
- Dynamic Pricing is now common in
  - Airlines
  - Hospitality
  - Retail
  - Electricity Trading
  - Entertainment
- Computer software using AI and machine learning is often employed to adjust prices automatically
- Rapid expansion of dynamic pricing to other industries

Dynamic Pricing as a Form of Price Discrimination, Part I

- Price discrimination is a pricing strategy where identical goods or services are sold at different prices to different consumers



Dynamic Pricing as a Form of Price Discrimination, Part II

- Examples of price discrimination:
  - discounts to students or senior citizens
  - quantity discounts
  - market segmentation, i.e. different prices in different countries
  - product bundling
  - ski passes, mobile phone operators tariffs
- Dynamic pricing is also known as intertemporal price discrimination
- Not always possible. For instance, there should be no possibility of resale. Because of that, price discrimination is more common in services
- There were attempts to limit price discrimination through anti-trust regulation. I.e. Robinson-Patman Act (USA, 1936) protects small businesses from being driven out of the marketplace by prohibiting discrimination in pricing and advertising by large chains
- Wave of market deregulation in 1980s also made dynamic pricing strategies more appealing

Examples of Dynamic Pricing

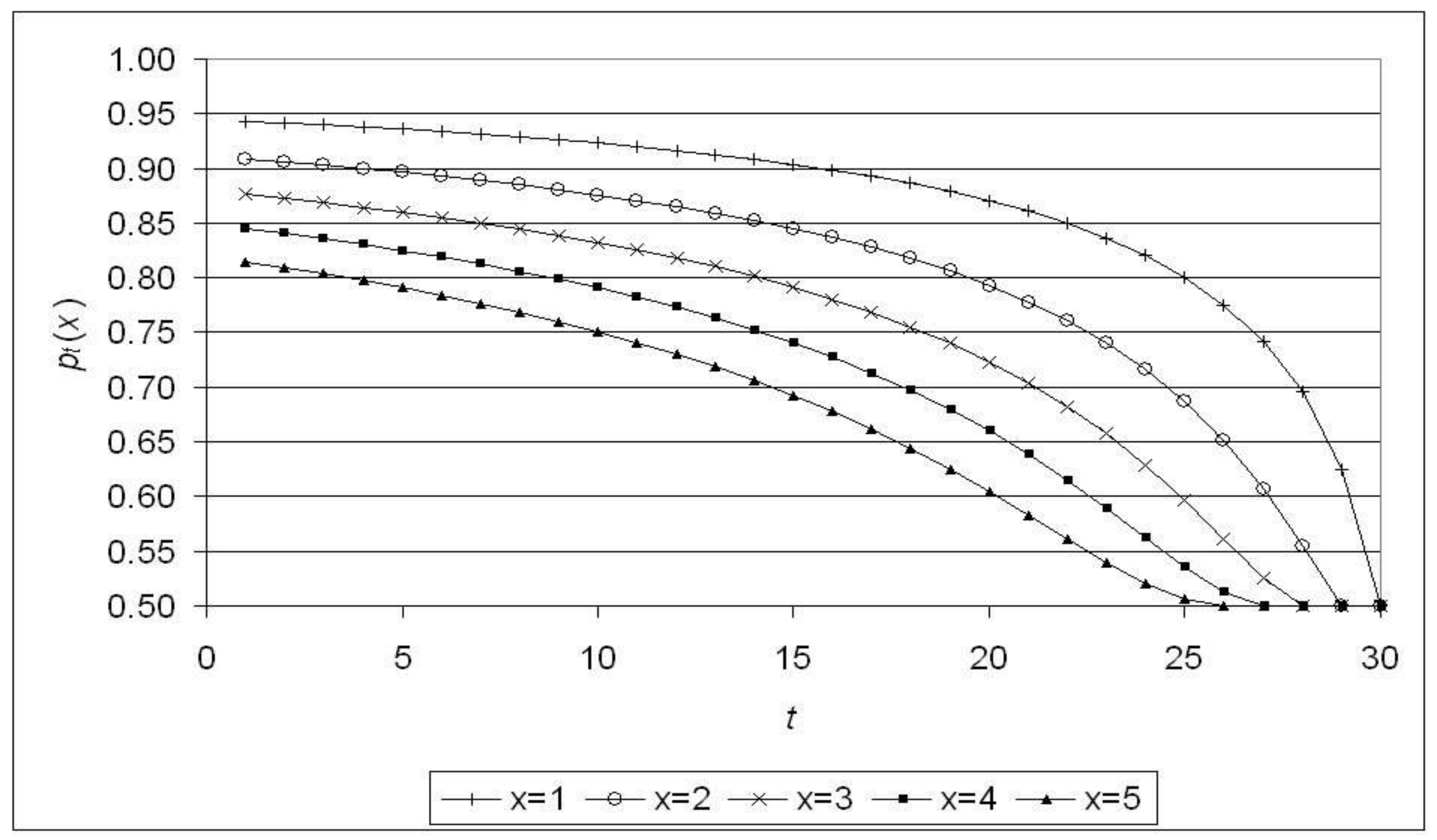
- Airlines
  - Prices can vary by an order of magnitude or even more
  - Pricing factors include departure time, season, day of the week, number of days before departure, average number of cancellations etc
  - Seats are sold through booking software that adjusts prices automatically
  - Overall, early-booking leisure travelers benefit at the expense of late-booking business travelers
- Similar strategies are now used in car rentals, hotels, show business etc.
- Retail
  - Clearance: price reductions towards the end of the season/expiration date
  - Sales: periodic price reductions for certain products
- Electricity (and, to lesser extent, other public utilities)
  - Predictable demand pattern during the day while generation is relatively constant
  - Setting higher prices for peak usage times to smooth out consumption
- Transportation - congestion pricing is used to reduce traffic within cities at peak times

Inventory-Based Dynamic Pricing: Basic Model

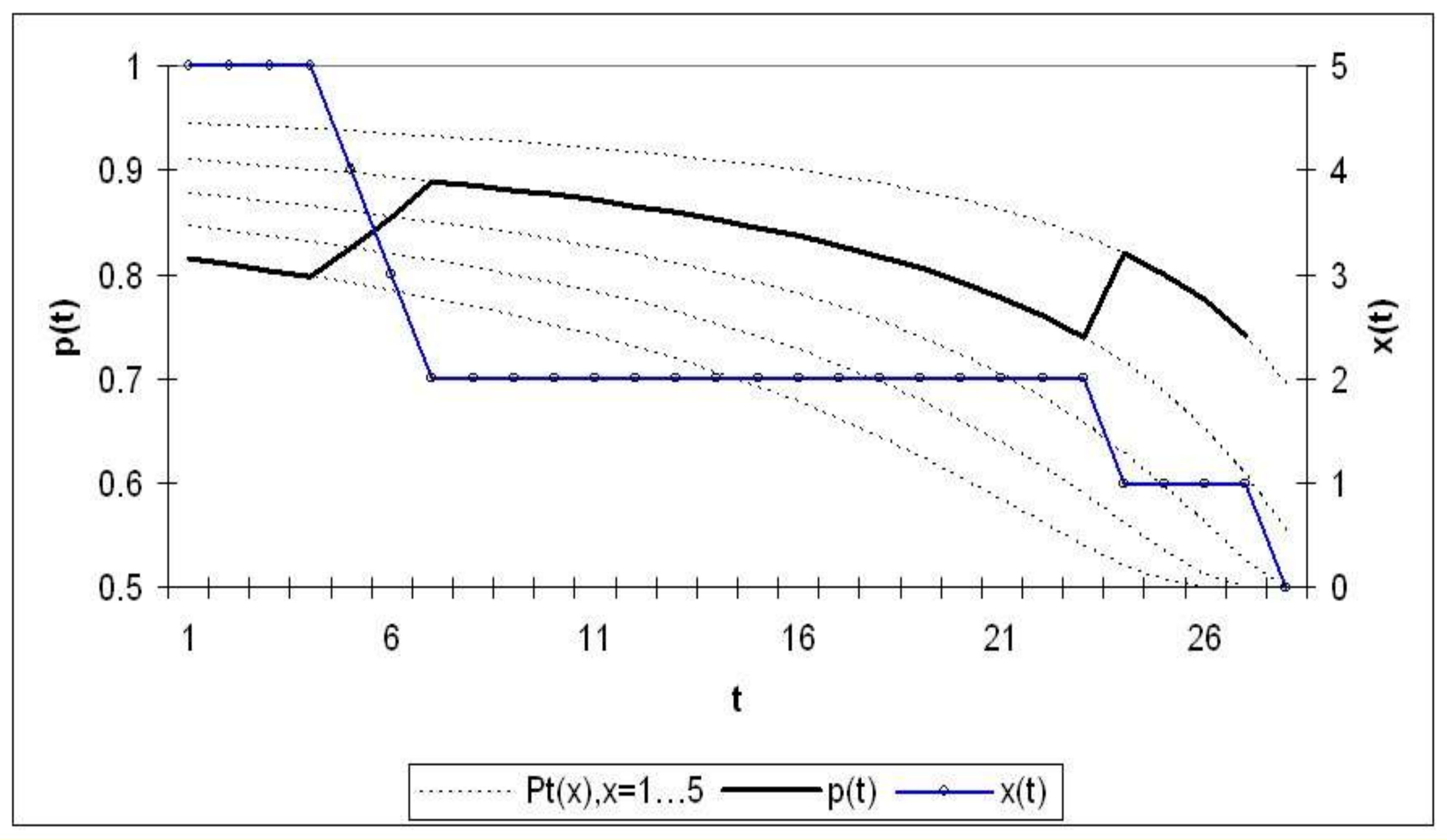
- Kincaid and Darling (1963), Gallego and van Ryzin (1994), many others
- Fixed time horizon that can be split into several selling periods
- Each period seller interacts with a single consumer
- Seller can set a new price for each period
- Chance of a successful sale (conversion rate) depends on a current price
- The objective is to maximize seller's revenue (as costs are assumed to be sunk)
- Ignores effects of competition or consumers' strategic behavior

Inventory-Based Dynamic Pricing: Single Product Case

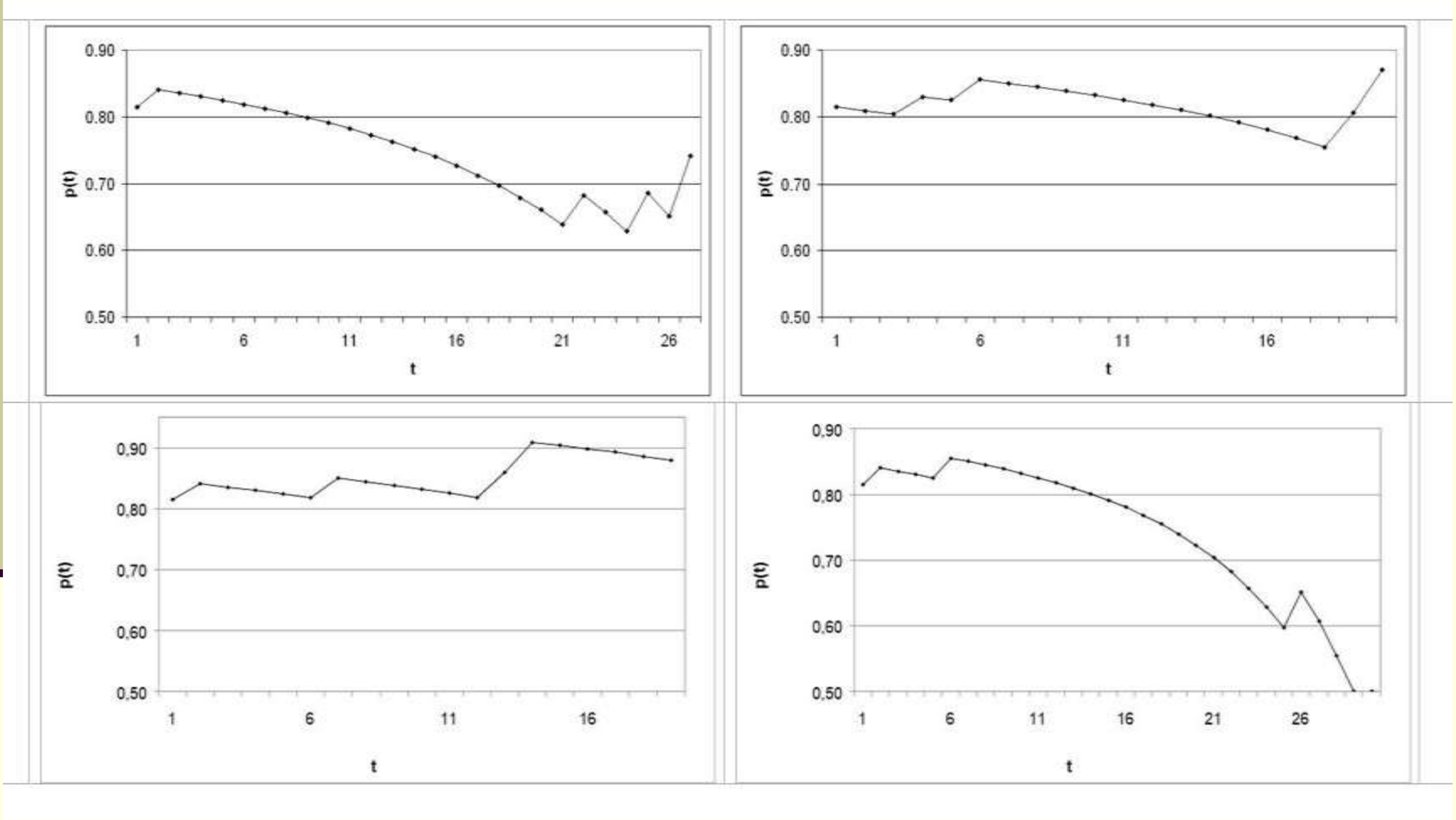
Inventory-Based Dynamic Pricing: Multiple Products Case



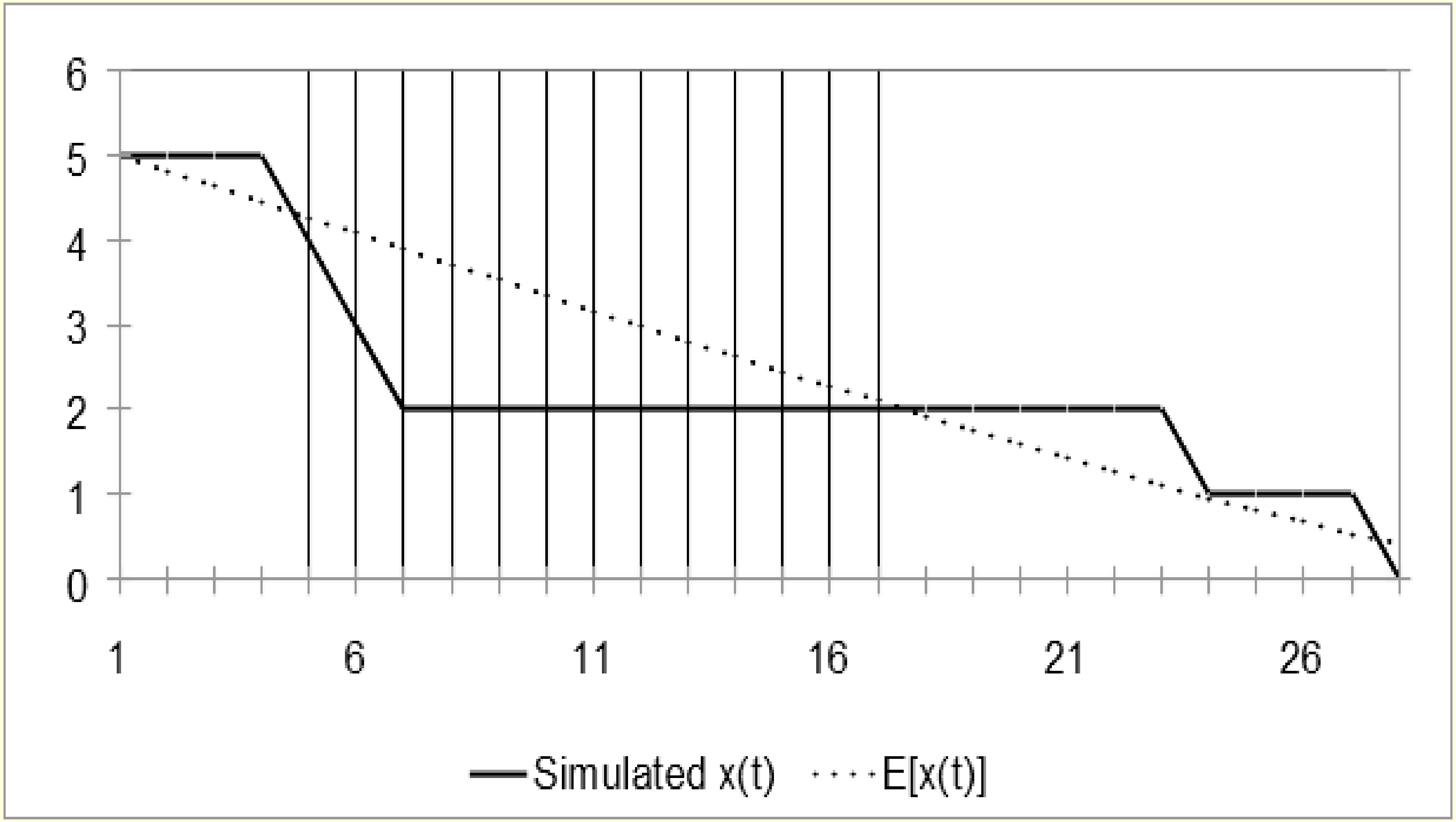
Inventory-Based Dynamic Pricing: How Price Adjustment Works



Inventory-Based Dynamic Pricing: Some Simulated Price Paths



Inventory-Based Dynamic Pricing: Intuitive Explanation



Inventory-Based Dynamic Pricing: Extensions

- Fixed Set of Prices
- Storage Costs
- Time-varying Demand
- Using Machine Learning to Estimate Demand and Adjust Pricing Rules
- Strategic Behavior of Consumers
  - Consumer Learning
  - Forward-looking Consumers
  - Coasian Conjecture
- Choice of Initial Stock Level
- Integrated Inventory Management & Yield Management Systems
- Impact of Competition

That's all for today!

- Thanks for your attention!
- Ačiū už dėmesį!
- Last but not least:
- Thanks for people of Lithuania for your unwavering support of Ukraine!