

# Determining Prices in the Information Technology Age: How Can "Just Prices" Be Achieved for Good?

by Mariusz Nitecki



# What are Just Prices

- Justice and fairness in pricing of products and services
- Equal exchange of value between buyer and seller
- Philosophized since ancient Greece (500 BC)
- Some principles defined by Christian scholars around 17<sup>th</sup> century
- Special importance in information technology age

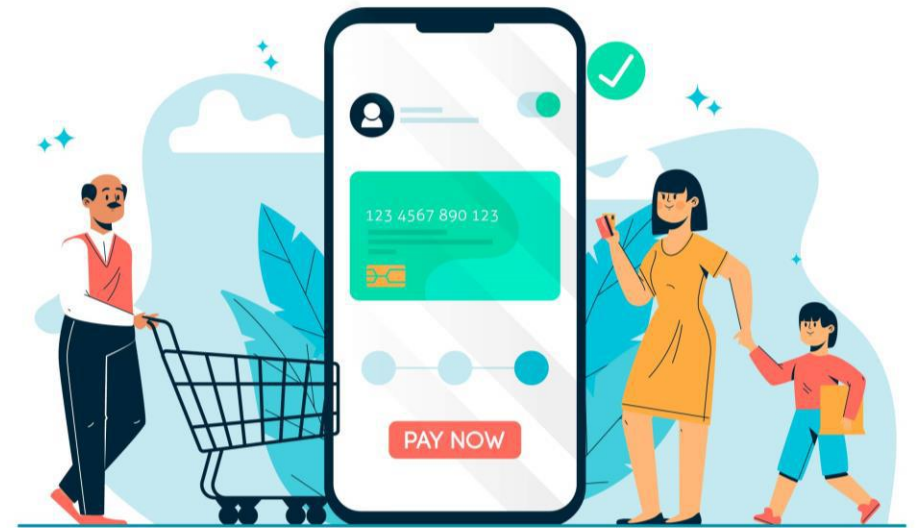
# Importance in Information Technology Age

Internet big part of exchange of goods and services

Growing importance of digital products

Pricing of digital goods unclear:

- Movie/Music licenses
- Copies of software
- Usage of internet itself



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# Scholastic Principles

## Cost-Of-Production Theory

Cost of production and labor  
+  
Reward for the seller according to level of  
profession  
=  
Price

## Subjective Utility Theory

Price = Utility it will provide

True value is the human need for the good,  
not intrinsic/materialistic value

→ Comparable to today's reservation price  
theory

# Scholastic Principles

Another important aspect is the “Natural Price”:

- Price that is a common estimation of the value of the product
- Comparable to competitive market price

This principle is used today in:

- Stock Markets
- Biddings
- ...

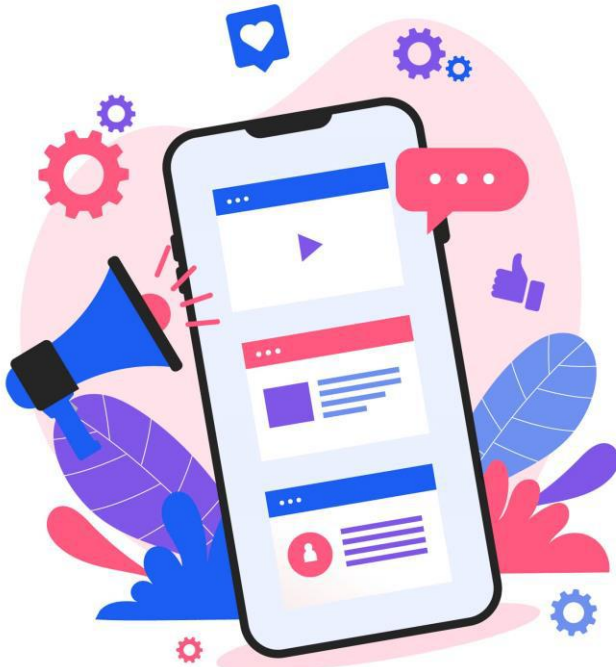
Question still remains: Are those prices fair?

- Goods on stock market often subject to speculations
- → Price of resources change, value remains the same



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# Current pricing methods



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Mobile internet providers most important service

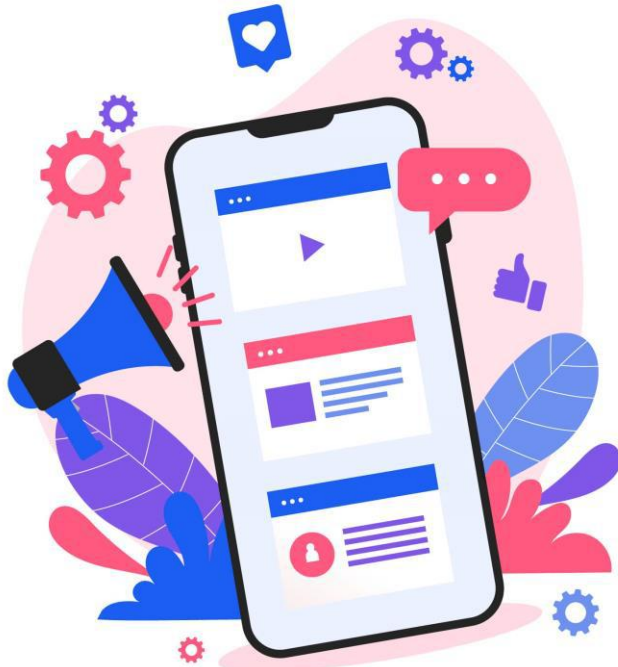
Pricing method → Internet packaging:

- Certain amount of GB allowed to use

Additional Costs:

- Incidental Cost  
Fees for administrative services like changing number, blocking SIM
- Overage Charges  
Costs for using mobile data over agreed limit

# Overage charges



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If exceeding this limit, every additional MB has to be bought

Prices for additional data exceeding limits very expensive

Providing one additional MB creates equal effort for the provider to data provided within contract

Why is one additional unit more expensive than the units before?

# Overage charges

Package prices of various providers

Bandwidth (Gb)	AT&T	Verizon	Sprint	T-mobile
.5				\$20
1				
2				
2.5				\$30
3			\$34.99	
4	\$30	\$30		
4.5				\$40
6	\$40	\$40	\$49.99	
6.5				\$50
8		\$50		
8.5				\$60
10	\$60	\$60		
10.5				\$70
12		\$70	\$79.99	Not Available
14		\$80		
15	\$90			
16		\$90		
18		\$100		
20	\$110	\$110		
30	\$185	\$185		
40	\$260	\$260		
50	\$335	\$335		

Price of additional bandwidth of various providers

Bandwidth (Gb)	AT&T	Verizon	Sprint
.5	60	\$60	\$69.98
1	\$30	\$30	\$34.99
2	\$17.50	\$17.50	\$16.67
2.5	\$12	\$12	<b>\$14</b>
3	\$10	\$10	\$11.66
4	<b>\$7.50</b>	<b>\$7.50</b>	\$21.55
4.5	\$10	\$10	\$30.53
6	<b>\$6.67</b>	<b>\$6.67</b>	<b>\$8.33</b>
6.5	\$8.46	\$8.46	\$15.57
8	\$8.75	<b>\$6.25</b>	\$19.05
8.5	\$10	\$7.65	\$22.62
10	<b>\$6</b>	<b>\$6</b>	\$25.48
10.5	\$7.14	\$7.14	<b>\$27.82</b>
12	\$7.50	<b>\$5.83</b>	\$6.67
14	\$8.57	<b>\$5.71</b>	\$13.03
15	<b>\$6</b>	\$6.33	\$15.57
16	\$6.88	<b>\$5.63</b>	\$17.80
18	\$6.11	<b>\$5.56</b>	\$21.51
20	<b>\$5.50</b>	<b>\$5.50</b>	\$24.48
30	<b>\$6.17</b>	<b>\$6.17</b>	\$33.39
40	<b>\$6.50</b>	<b>\$6.50</b>	\$37.84
50	<b>\$6.70</b>	<b>\$6.70</b>	\$40.51



# Streaming Services

2010s new method of pricing digital media

→ Subscription based Model



Access to big database of movies/music for small monthly payment

→ Provider only makes profit with big amount of customers

Many providers: Spotify, Netflix, Disney+, Apple Music, ...

Too strong price discounting – provider not receiving equal value

→ Prices not Just!

# Data Collection to Determine Prices

Profiles are created for every individual using information like:

- Age
- Sex
- Interests
- Online behavior
- Address
- Estimated income
- ...

Using behavioral and non-behavioral data about user to determine prices based on:

- Location
- Estimated reservation price
- Interest
- Demographic features
- ...



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# Behavioral Data Collection

Information about users behavior is collected:

- Browsing behavior
- Time spent on websites and subpages
- Clicking behavior
- Visiting frequency

No personal or identifiable information

Different technologies available:

- LOG Files
- CGI-based Files
- Cookies
- Special purpose software



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# Log Files

Recording of connection between client (user) and provider (server)

→ client-server principle

Collected data include:

- IP Address
- User ID
- Time and date
- URL Request
- Agent
- Referrer (previously visited website)

IP Address	User id	Time	Request (Method/URL/Protocol)	Status	Size	Referrer	Agent
123.456.78.8	--	[09/May/2001:03:04:41 - 0500]	"Get Buxel.html HTTP/1.0"	200	3290	—	Mozilla/3.04 (Win95,I)
123.456.78.8	--	[09/May/2001:03:04:51 - 0500]	"Get Wiedmann.html HTTP/1.0"	200	5450	Buxel.html	Mozilla/3.04 (Win95,I)
123.456.78.8	--	[09/May/2001:03:05:32 - 0500]	"POST/cgi-bin/p1HTTP/1.0"	200	5096	Wiedmann.html	Mozilla/3.04 (Win95,I)
123.456.78.8	--	[09/May/2001:03:05:41 - 0500]	"Get Buxel.html HTTP/1.0"	200	3290	—	Mozilla (IE4.2,WinNT)
123.456.78.8	--	[09/May/2001:03:05:59 - 0500]	"Get Wiedmann.html HTTP/1.0"	200	5450	Buxel.html	Mozilla (IE4.2,WinNT)
123.456.78.8	--	[09/May/2001:03:06:30 - 0500]	"Get Frenzel.html HTTP/1.0"	200	1000	Wiedmann.html	Mozilla (IE4.2,WinNT)
123.456.78.8	--	[09/May/2001:03:07:11 - 0500]	"Get Buckler.html HTTP/1.0"	200	2020	F.html	Mozilla/3.04 (Win95,I)
123.456.78.8	--	[09/May/2001:03:07:45 - 0500]	"Get Halstrup.html HTTP/1.0"	200	3030	Frenzel.html	Mozilla (IE4.2,WinNT)
123.456.78.8	--	[09/May/2001:03:12:23 - 0500]	"Get Meissner.html HTTP/1.0"	200	4040	Wiedmann.html	Mozilla/3.04 (Win95,I)
123.456.78.2	--	[09/May/2001:05:05:11 - 0500]	"Get Buxel.html HTTP/1.0"	200	3290	—	Mozilla/3.04 (Win95,I)
123.456.78.3	--	[09/May/2001:05:06:03 - 0500]	"Get Walsh.html HTTP/1.0"	200	4040	Buxel.html	Mozilla/3.04 (Win95,I)
123.456.78.5	--	[09/May/2001:05:06:05 - 0500]	"Get robots.txt"	200	1020	—	Mozilla/3.04 (Win95,I)
233.999.79.4	--	[09/May/2001:05:06:07 - 0500]	"Get Buxel.html HTTP/1.0"	200	3290	—	Ultraseek

# CGI-Files & Cookies

## CGI-based Files:

- Common Gateway Interface used between web forms and programs for communication and recording of user activities
- Saves additionally:
  - Access patterns
  - Client certificate
  - Certificate issuer
  - Location
- Supplements Log file data

## Cookies:

- Small data structures sent from a Web server to users browser and saved on users hard drive
- → With sufficient information sent back to server
- Data saved can be specified by provider:
  - Language preferences
  - Entered web forms
  - Search terms
  - Visited subpages

# Non-Behavioral Data Collection

- Personal and identifiable information about a person:
  - Demographic
  - Socio-economic status
  - Psychographic profile
  - Interests
  - ...
- Often derived from behavioral data  
(e.g. search behavior shows interests, hobbies)
- Retrieved from entered web forms  
(e.g. creating account and entering address, e-mail, ... )

# Processing of data using prediction models

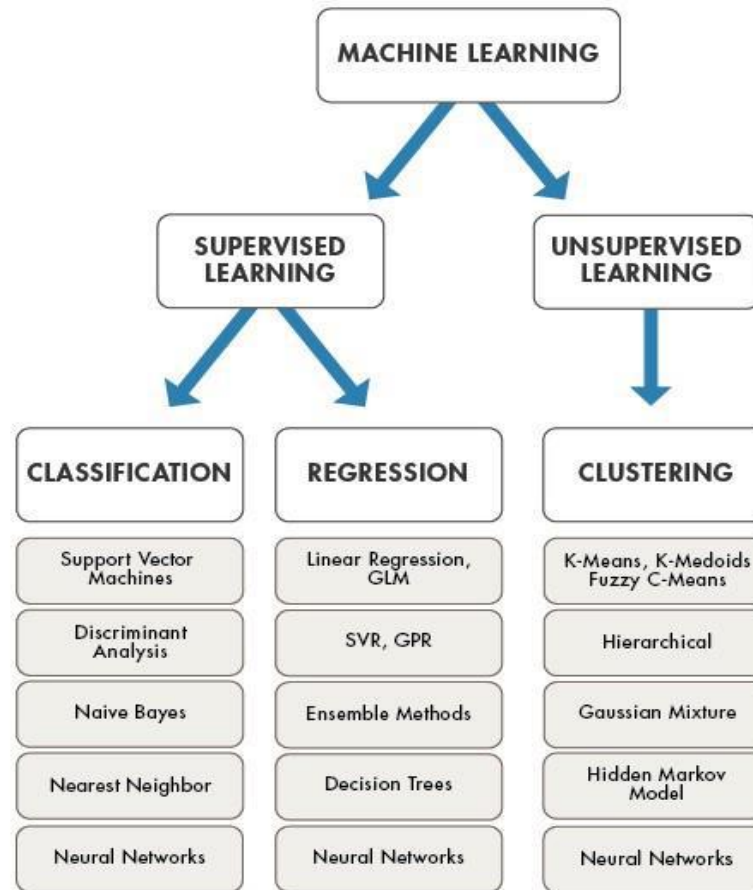


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Use of different Machine Learning algorithms to analyze patterns in existing data and predict new information:

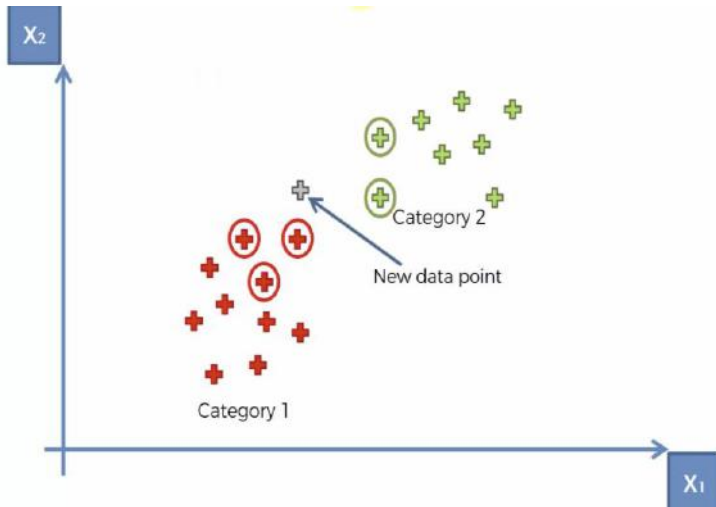
- Prediction of behavior of customers
- Mining information in order to optimize service
- Find out future purchasing preferences
- Possibility arises to predict/calculate optimal prices (e.g. reservation prices) for individuals based on collected data

# Machine Learning





# Example: k-Nearest-Neighbors



- Grey cross (unknown entry) is classified to the cluster where  $k$  nearest neighbors belong
- Distance to neighbors is calculated based on given features
- Classification can be a unknown attribute of the data point (e.g. Netflix predicts movie the user would like based on people with similar media consuming behavior)

# Pricing based on data

Some suggestions:

- Adjusting prices to regional average income using users location (e.g. has higher income/prices than Austria → prices should be adjusted accordingly, differentiating poorer/richer region)
- Use demographic information to set prices (e.g. younger clientele often have limited budgets)
- Use behavior tracking (e.g. time spent on site, ...) to estimate/predict reservation price (= how much value the product poses for the potential buyer)

# Thank you for your attention



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