Agent based simulation of dynamic pricing policies of academic courses

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Research Practice II: Final Presentation

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The problem

The problem

- EAFIT's Language Center is looking for ways to improve their revenue
- Dynamic pricing seems like an option

Centro de Idiomas
Universidad EAFIT

The problem

Some questions appeared:

- What is a dynamic pricing policy?
- Could simulation help in this problem?

If so:

- How could we represent the system in a simulation?
- What questions could the simulation model answer?

What is dynamic pricing (DP)?

- It is a pricing policy that aims to increase revenue
- It is used for items that are seasonal or cannot be stored
- It depends on the market supply and demand characteristics
- The policy seeks an optimal price strategy

Could simulation help in this problem?

Specifically Agent Based Modeling and Simulation ABMS

- Simulation as a tool for decision making processes
- Represent individuals, their behavior and interactions
- Offers the possibility of evaluating scenarios
- It has been used to model DP in the energy market

The objective

Objectives

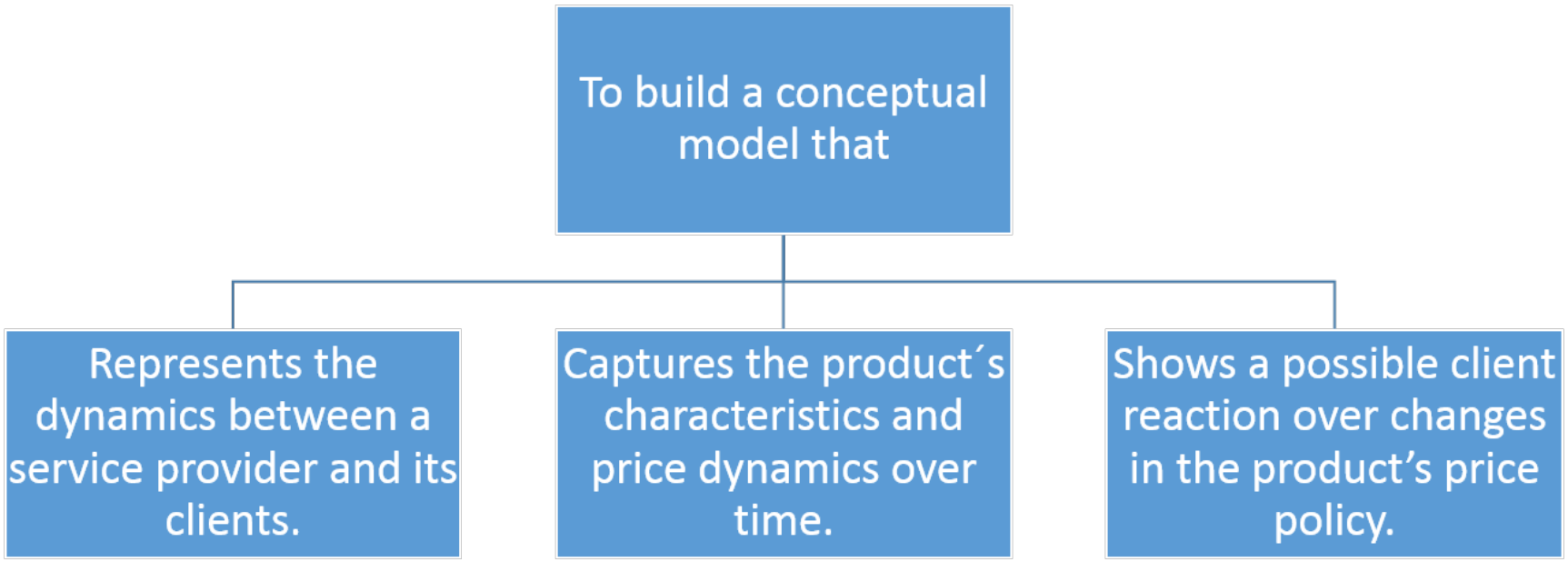


Figure: Objectives diagram

How to achieve them?

- Literature review
- Conceptual modeling
- Model validation and verification
- Model codification

Literature review

Literature review

A systematic search was conducted using the WOS scientific citation index

Searched string	Years of search	Number of results
('Agent based' AND 'dynamic pricing')	All	649
	2005 - 2015	540
((('Agent based') AND ('dynamic pricing')) AND ('academic courses')))	All	0
(('dynamic pricing') AND ('academic courses'))	All	0

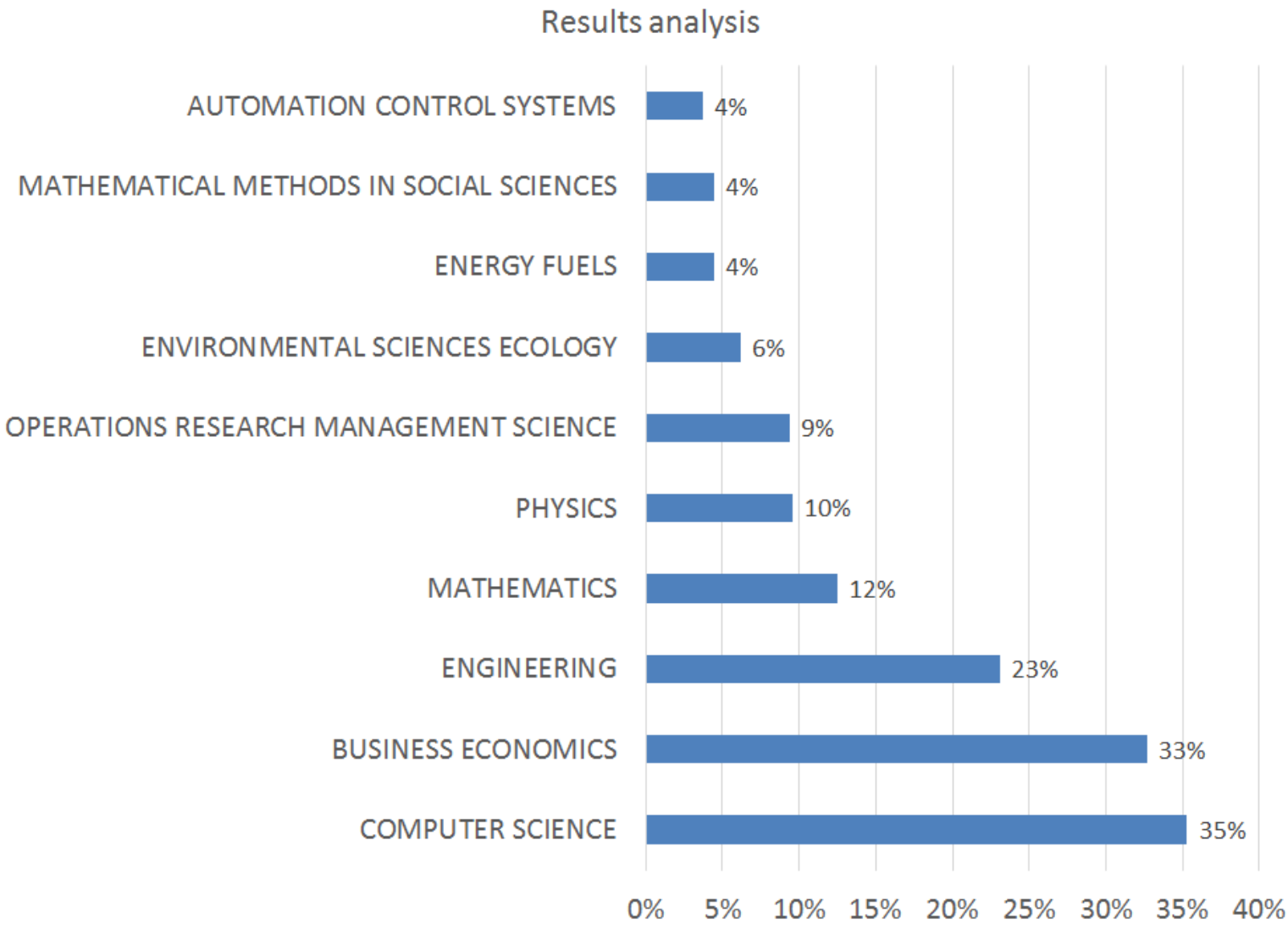


Figure: Systematic search results by area of research

Systematic search

In general, business economics and computer sciences are the two areas in which the majority of results are found, being mathematics and operation research our two most important reference areas.

Systematic search

Redefining the search parameters

Searched string	Years of search	Number of results
((('dynamic pricing') OR ('revenue management')) AND ((academic courses) OR (tuition fees) OR (university schedule)))	All	42
	2005 - 2015	20
("tuition" AND "pricing")	All	27
	2005 - 2015	18

In general, among the previous work:

- The energy market provides some applications of DP, there are important model developments that could help in our model development
- There are several studies that try to increase revenue for educational institutions, but they do not apply dynamic pricing policies
- There are several pricing strategies and examples of measuring core fundamentals regarding the application and description of the demand
- The dynamic pricing strategies have not been used on academic courses

Conceptual model methodology

Methodology

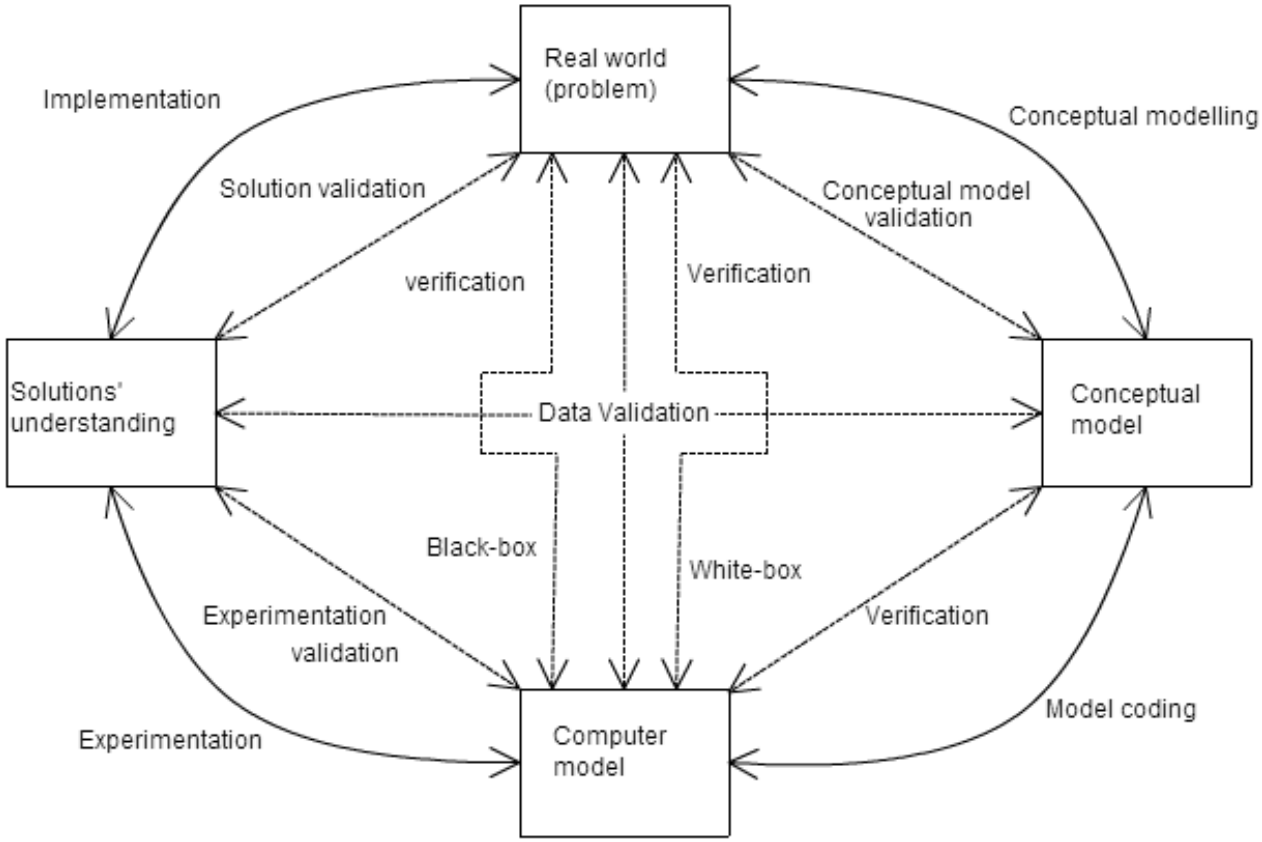


Figure: Methodology proposed by Tako, A. & Robinson, S. (2010)

Methodology

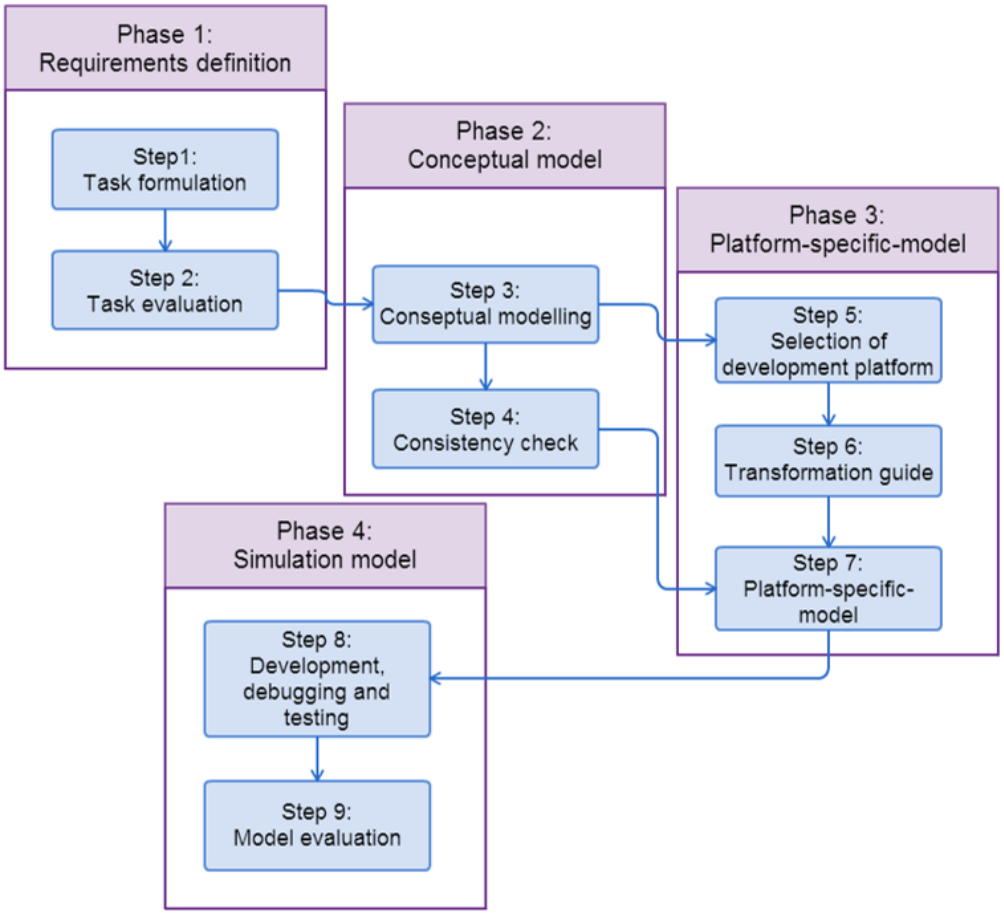


Figure: Methodology proposed by Salamon, T. (2011)

Model design

Task formulation

The investigation questions are staked. In this case, the conceptual model implementation should answer these questions:

- Can the client's behaviors be replicated and explained using an energy auction model?
- What could be a plausible client reaction towards a change in the course pricing policy?

As an initial approach the problem will be reduced to one language class

Conceptual modeling

In this step the task set before is transformed into a conceptual model

- The basic structure of an energy auction model in a general description contemplates two types of agents, the energy producers that have a production capacity and they set a selling price for the energy, and the auction market regulator that starts buying energy from the cheapest seller up until its demand is satisfied

Conceptual modeling

In the adaptation we plane to do:

- The energy producers will represent the clients
- The selling price will become the maximum price each customer is willing to pay for the service provided
- The language center will be represented by the auction market regulator
- The demand will represent the maximum number of students per course

The "Client" agent

His goal will be to set a maximum buying price

- This action requires a further investigation on how to model and simulate such aspects
- This will determine key inputs of the model and should be measurable and acquirable for the model application
- The clients do not have the need to communicate or interact among them, but they need to communicate with the service provider in order to make the buying decision, this is a behavior that can be replicated from the online auction models in the literature

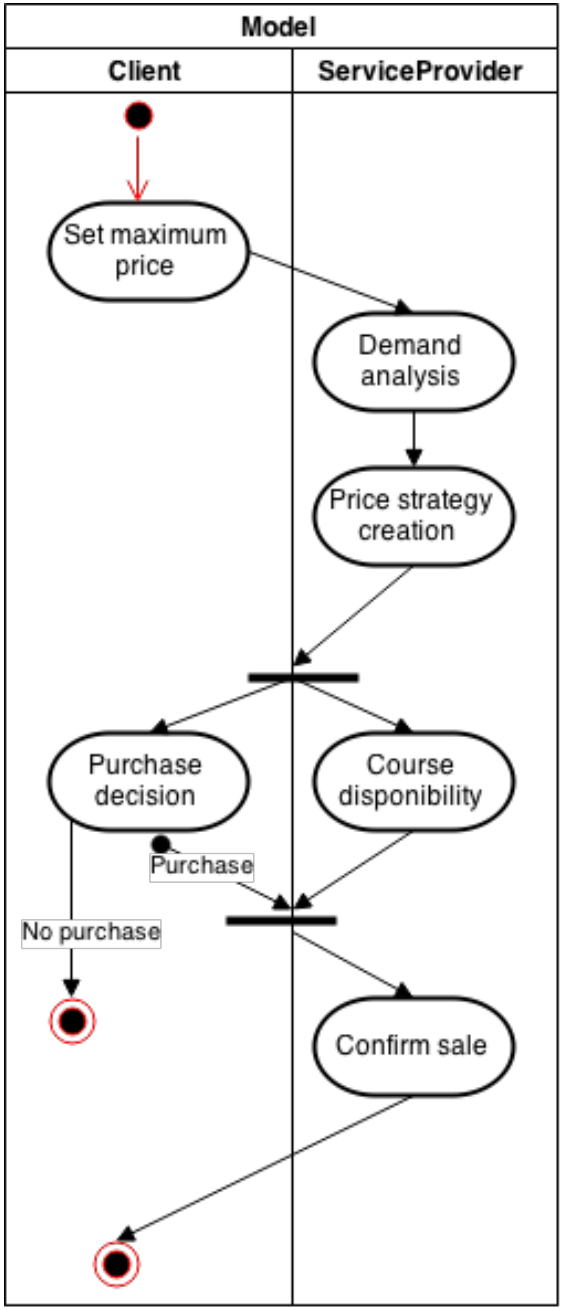
The "ServiceProvider" agent

The goal will be to maximize its revenue, this will be achieved by processing all clients' maximum buying prices and finding the value range in which the course is all sell out

- then a discretization of this range will determine the dynamic pricing segmentation
- After the pricing strategy is determined, the simulation will continue until the sales horizon ends

Once it stops two things can happen:

- The total number of clients that are able to pay for the course based on the pricing strategy will be determined
- The "ServiceProvider" will determine not to open the course since its equilibrium point has not been reached.


Model
Client
ServiceProvider
Set maximum price
Demand analysis
Price strategy creation
Purchase decision
Course disponibility
Purchase
No purchase
Confirm sale

Conclusions and further work

Conclusions and further work I

- The conceptual modeling process is ongoing and is proven to require more time than anticipated, nevertheless the methodology provided by Salamon [1] and Tako & Robinson [2] has been a fundamental guide and benchmark in the process. That being said, the further work will propose the continuation of the conceptual model creation accordingly to the methodology described in this work.
- Further research is needed to determine the maximum buying price for the clients. There may be mathematical models in economics that could provide a solution for this problem.

Conclusions and further work II

- The discretization or the price range made by the "ServiceProvider" could be made from various approaches; game theory or optimization models could be of use.
- In a further work, the validation and verification process should have a more active role.

Thanks for your attention!
Any questions?

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