On the Use of Fuzzy Logic in a Seller Bargaining Game

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Outline

- Introduction
- Market members
- Buyer-Seller Interaction
- Seller Behavior
- Fuzzy Approach
- Results

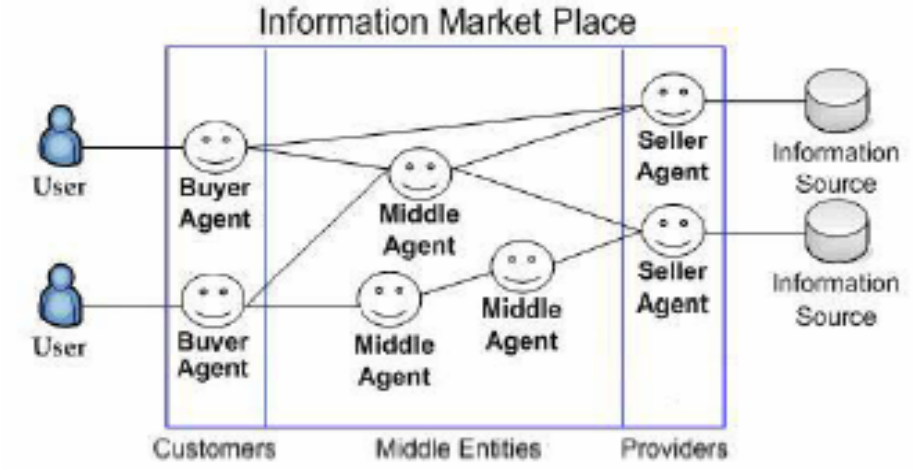
Introduction

- Intelligent Agents
  - Autonomous Software Components
  - Represent users
  - Learn from their owners
- Information Markets
  - Places where entities negotiate for the exchange of information goods

Market Member Roles

- Buyers
- Sellers
- Middle entities (matchmakers, brokers, market entities)

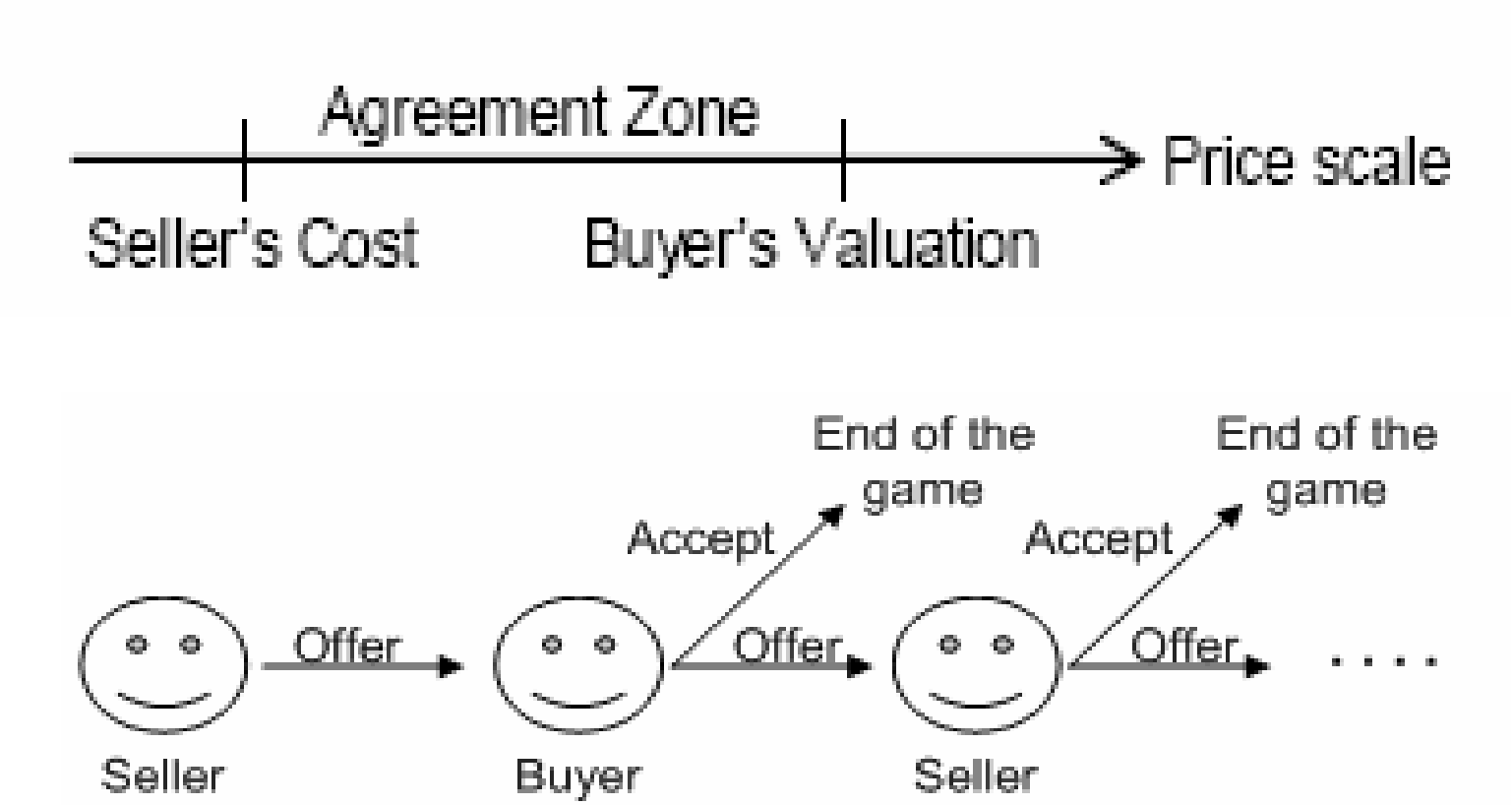
➔ Intelligent Agents may represent each of these entities



Buyer-Seller Interaction (1/2)

- Can be modeled as a finite horizon Bargaining Game (BG)
- No knowledge about the characteristics of the opponent (i.e., the other side) is available
- The buyer aims to buy the product at the lowest possible price while the seller aims to sell the product at the highest possible price
- The buyer has a specific valuation for the product
- The seller has a specific production cost
- The two players have specific deadlines to conclude the transaction

Buyer-Seller Interaction (2/2)



Seller Behavior (1/6)

- The seller stays in the game for a specific number of rounds
- Profit
  - Profit = price – production/retrieval cost
  - The greater the price is the greater the profit becomes

Seller Behavior (2/6)

- Pricing Policy
  - Based on: the cost (c), an amount of profit (ε), the proposal's ordinal number (x) and the popularity measure (q):

$$p^s(x) = \frac{\varepsilon}{x^{q+1}} + c, \qquad x = 1,2,....$$

  - The popularity measure depends on the product's cache ranking and is considered Zipfian

$$q = i^{-k}$$

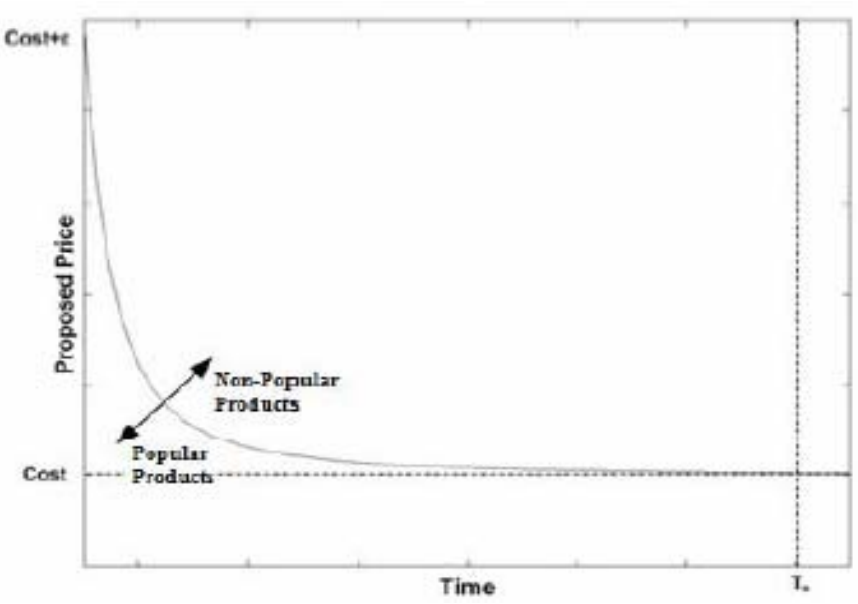
i denotes the product's ranking and k is the Zipf parameter

Seller Behavior (3/6)

- Pricing Policy (continued)
  - The seller behaves as a caching server
  - Products are delivered to interested parties more than once
  - Products are classified according to their popularity

Seller Behavior (4/6)

- Pricing Policy (continued)
  - The seller concludes rapidly the game for popular products
  - The seller does not sell the product below cost



Seller Behavior (5/6)

- Deadline calculation
  - Based on its pricing function a deadline value could be defined if:

$$\lim_{x \to \infty} \left[\frac{-\varepsilon \cdot (\mathrm{q}+1)}{x^{q+2}} \right] = 0$$

Where x is the ordinal number of the proposal

$$x^{q+2} \approx \alpha \cdot \varepsilon \cdot (\mathrm{q}+1) \rightarrow T_s \approx (\alpha \cdot \varepsilon \cdot (\mathrm{q}+1))^{\frac{1}{\mathrm{q}+2}}$$

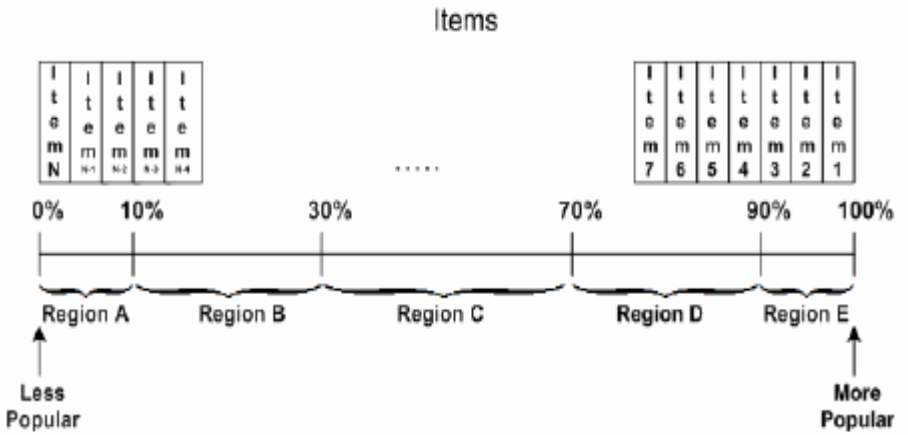
  - Variable α is the patience factor of the seller

Seller Behavior (6/6)

- Patience factor
  - based on the policy of the seller
  - indicates the patience of the seller
  - The greater the factor is the more time the seller spends in the game
  - indicates until when the game is meaningful for the seller

Fuzzy Rules (1/3)

- They define the value of α
- They deal with:
  - Popularity parameter q
    - *Very Low: Region A*
    - *Low: Region B*
    - *Medium: Region C*
    - *High: Region D*
    - *Very High: Region E*
  - Profit ε (*Low, Medium, High*)



Fuzzy Rules (2/3)

- Values of α are:
  - *Very Low*: Very impatient player
  - *Low*: Impatient Player
  - *Medium*: Neutral about the termination of the game
  - *High*: Patient player
  - *Very High*: Very patient player

Fuzzy Rules (3/3)

- Rule examples:

if (*q* is *very low* AND (*ε* is *low* OR *ε* is *medium*)) then *a* is *very High*

if (*q* is *very high* AND (*ε* is *medium* OR *ε* is *high*)) then *a* is *very low*

Results (1/2)

- We used $\alpha_{max} = 1000$.
- Our model calculates the appropriate value for α.
- The deadline depends on the product's characteristics.

Profit (ε)	Popularity parameter (q)	T_s for α=50	New α value	New T_s
5	1	6	89.4	10
5	0.4	8	275	23
10	1	7	15.8	7
10	0.4	10	275	31
10	0.7	9	89.4	15
10	*0.2*	*12*	*588*	*56*
20	1	9	15.8	9
20	0.4	14	275	42

Results (2/2)

- The appropriate deadline could be greater or less than the deadline specified using crisp values for α.

Profit (ε)	Popularity parameter (q)	T_s for α=50	New α value	New T_s
10	1	10	15.8	7
20	1	13	15.8	9

Thank you!

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