

PERSONALIZED DISCOUNT

A Fuzzy Logic Approach

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1. **Motivation**
2. Fuzzy Classification Concept
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- A growing challenge for companies in the e-business era is the customer retention.
- A fuzzy classification of customers can:
 - Improve customer equity
 - Calculate a personalized discount
 - Launch and verify marketing campaigns
 - Analyze customers' evolution

- The fuzzy classification approach is a combination of relational databases and fuzzy logic:
 - Reduce the complexity of the customer data
 - Extract valuable hidden information
 - Enable the use of non-numerical values
 - Query on a linguistic level
 - No data migration needed

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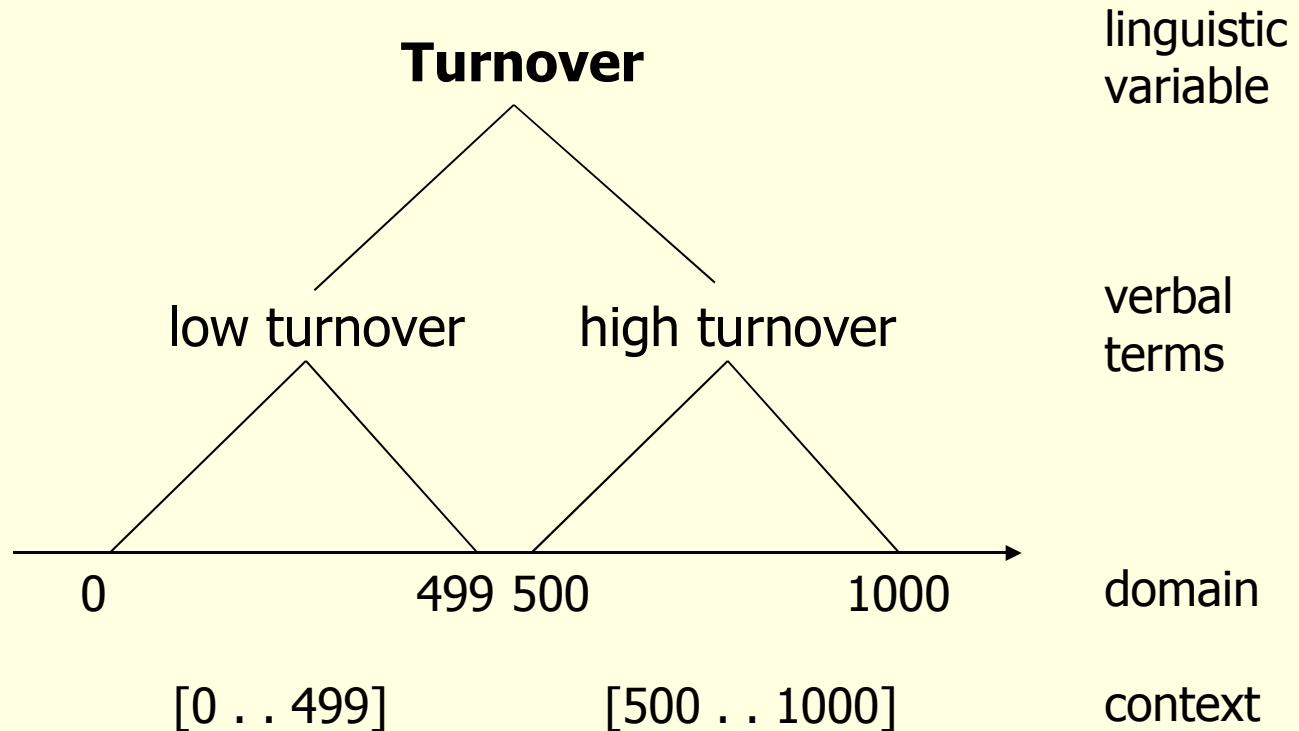
Context Model

- Extend the relational model by a context model:
 - To every attribute A_j defined by its domain $D(A_j)$, we add a context $K(A_j)$
 - A context $K(A_j)$ is a partition of $D(A_j)$ into equivalence classes
- Relational database schema with contexts $R(A, K)$ where $A = (A_1, \dots, A_n)$ and $K = (K_1(A_1), \dots, K_n(A_n))$

Classification Example

- Classification of customers based on two attributes:
 - **Turnover** [0,1000] with:
 - *low turnover* [0,499]
 - *high turnover* [500,1000]
 - **Payment behaviour** {in advance, on time, behind time, too late} with:
 - *attractive payment behaviour* {in advance, on time}
 - *non-attractive payment behaviour* {behind time, too late}

Linguistic Variable



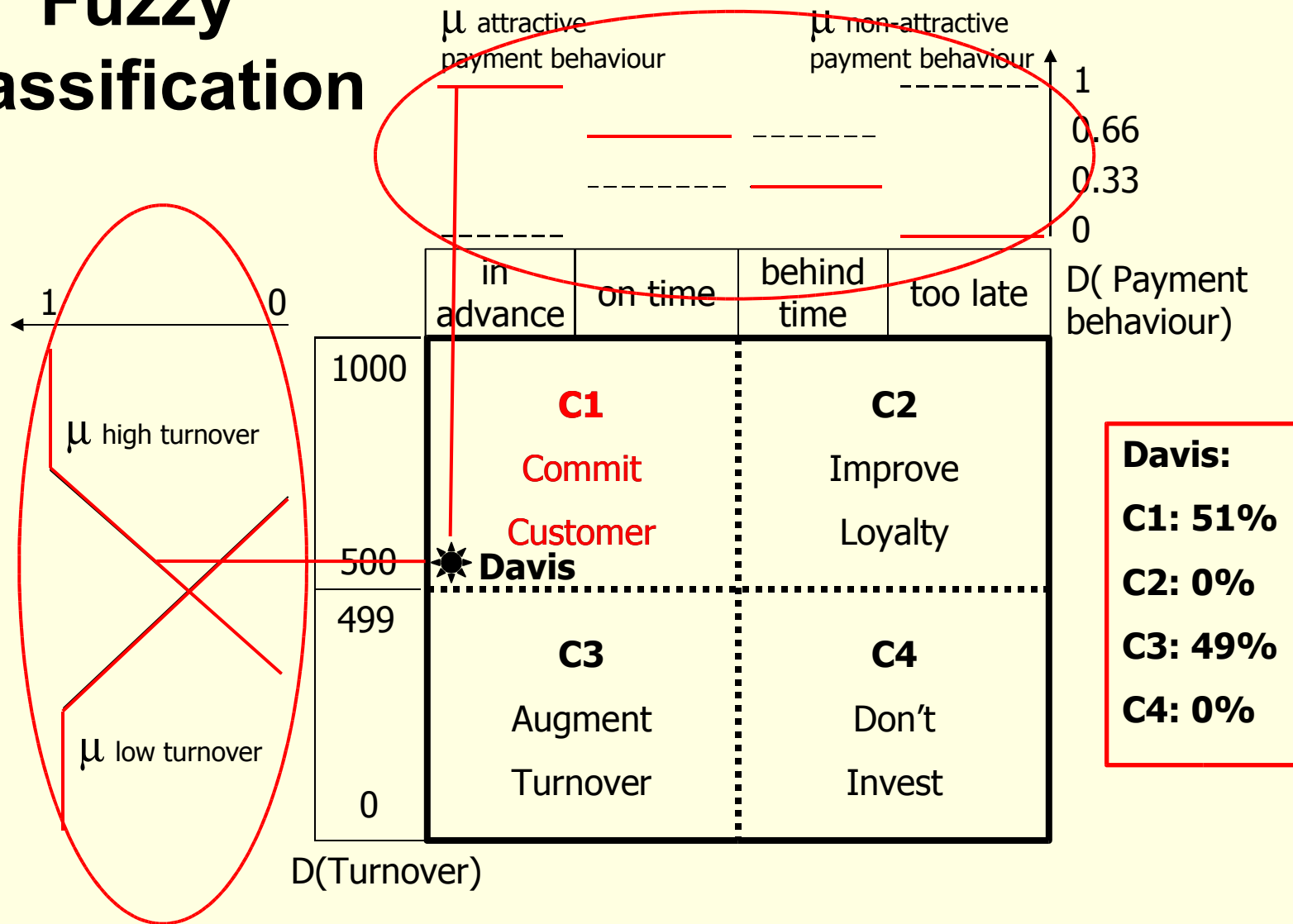
Sharp Classification

Classification

		attractive payment behaviour		non-attractive payment behaviour		D(Payment behaviour)
		in advance	on time	behind time	too late	
high turnover	1000	C1 Commit Customer		C2 Improve Loyalty		
	500					
low turnover	499	C3 Augment Turnover		C4 Don't Invest		
	0					
		D(Turnover)				

2. Fuzzy Classification Concept

Fuzzy Classification



Aggregation of Fuzzy Sets

- The minimum operator
- The γ -operator

$$\mu_{A_i}(x) = \left(\prod_{i=1}^m \mu_i(x) \right)^{(1-\gamma)} \left(1 - \prod_{i=1}^m (1 - \mu_i(x)) \right)^{\gamma}$$

Where $x \in X$, $0 \leq \gamma \leq 1$

Fuzzy vs. Sharp Classification

- The elements can be classified in several classes:
 - Each element has one or several membership degrees indicating to what extent it belongs to the different classes
 - Disappearance of the classes' sharp borders
- Accurate information of the classified elements

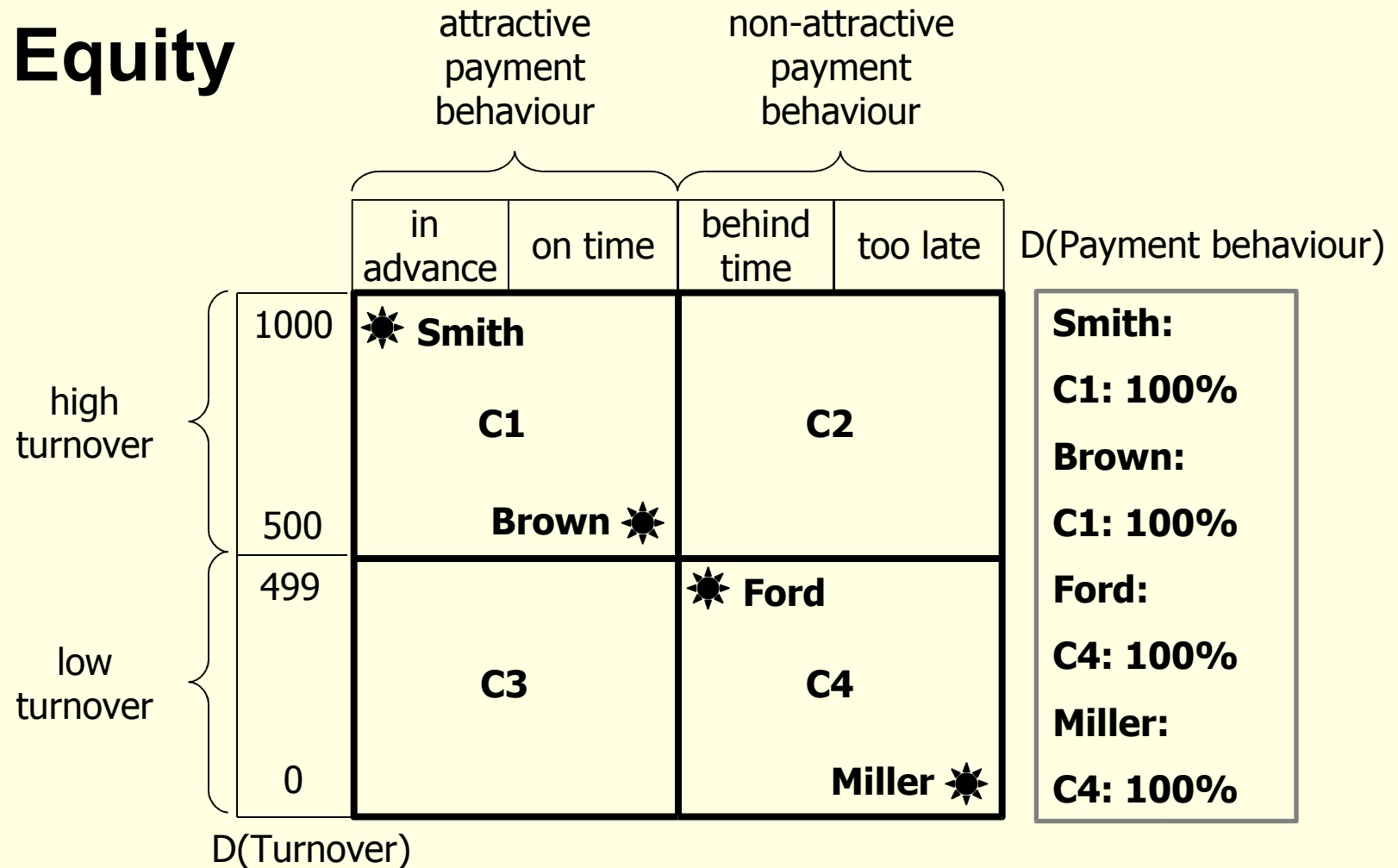
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Customer Equity

- The customer equity suggests that we should treat the customers to their real value
- A sharp classification cannot drive customer equity as every customer of a class is treated the same
- A fuzzy classification can realize the customer equity. The membership degrees of a customer in the different classes represent the real value of the customer and therefore can determine the privileges this customer deserves

3. Fuzzy Customer Classes

Customer Equity



3. Fuzzy Customer Classes

Customer Equity

μ attractive
payment behaviour

μ non-attractive
payment behaviour

1
0.66
0.33
0

in advance on time behind time too late

D(Payment behaviour)

1000

★ **Smith**

C1

C2

500

Brown ★

499

★ **Ford**

C3

C4

0

Miller ★

D(Turnover)

Smith:

C1:100; C2:0; C3:0; C4:0

Brown:

C1:35; C2:17; C3:32; C4:16

Ford:

C1:16; C2:32; C3:17; C4:35

Miller:

C1:0; C2:0; C3:0; C4:100

Personalized Discount

- According to the customer equity principle, a personalized discount can be derived:
 - Discount rates can be associated with each fuzzy class: C1: 10%, C2: 5%, C3: 3%, C4: 0%
 - The individual discount of a customer can be calculated as the aggregation of the discount of the classes he belongs to, in proportion of his membership degrees in the classes

3. Fuzzy Customer Classes

	in advance	on time	behind time	too late
1000	★ Smith C1 10%		C2 5%	
500	Brown ★			
499	C3 3%		★ Ford C4 0%	
0			Miller ★	

D(Payment behaviour)

Smith:

C1:100; C2:0; C3:0; C4:0

Brown:

C1:35; C2:17; C3:32; C4:16

Ford:

C1:16; C2:32; C3:17; C4:35

Miller:

C1:0; C2:0; C3:0; C4:100

D(Turnover)

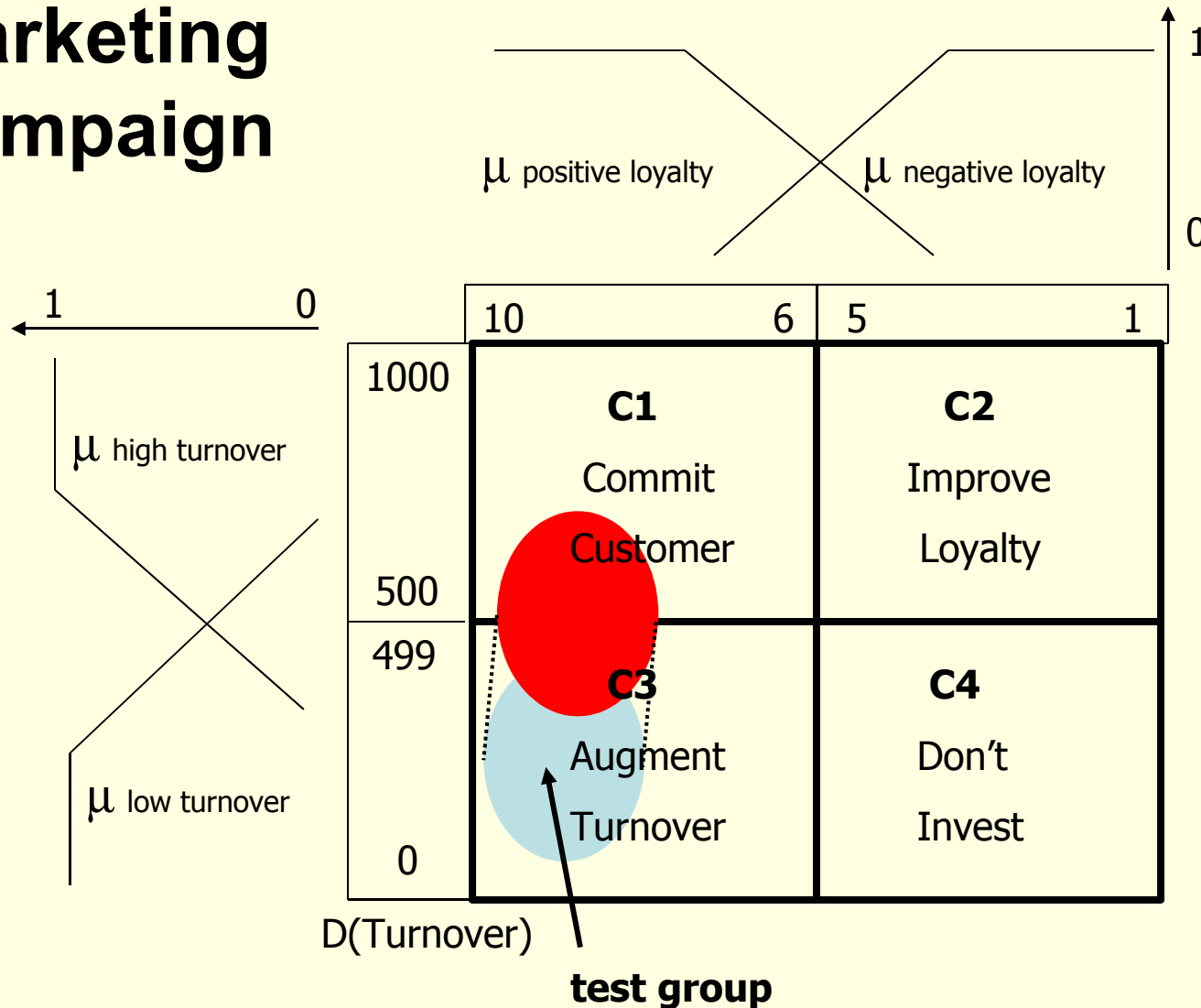
- **Smith:** $1 * 10\% + 0 * 5\% + 0 * 3\% + 0 * 0\% = 10\%$
- **Brown:** $0.35 * 10\% + 0.17 * 5\% + 0.32 * 3\% + 0.16 * 0\% = 5.3\%$
- **Ford:** $0.16 * 10\% + 0.32 * 5\% + 0.17 * 3\% + 0.35 * 0\% = 3.7\%$
- **Miller:** $0 * 10\% + 0 * 5\% + 0 * 3\% + 1 * 0\% = 0\%$

Marketing Campaign

- Launching a marketing campaign can be very expensive
 - Select the most appropriate customers
 - Verify the impact of the campaign in order to improve the target group

3. Fuzzy Customer Classes

Marketing Campaign



Customers' Evolution

- With a fuzzy classification, there is the possibility of monitoring the customers through the classes
 - Detect customers who are:
 - Improving
 - Maintaining
 - Decreasing
 - Avoid customer churning

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Conclusion

The fuzzy classification, by giving a more precise information of the classified elements, allows to:

- Avoid the gaps between the classes
 - No more inequities
- Calculate a personalized discount
 - No ejection of potentially good customers and better retention of the top customers
- Verify the impact of a marketing campaign
 - More efficient marketing campaign
- Monitor the customers' evolution
 - Avoid good customer churn

Outlook

- Adaptation of the marketing mix theory to take advantage of the fuzzy customer classes
- Implementation of the personalized discount in the open source eSarine webshop

Questions ???