Presentation Title

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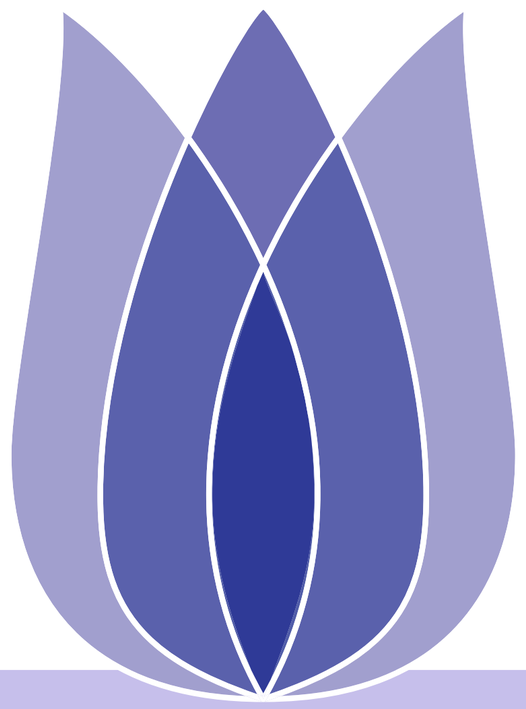
(None)



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Aggregation Functions

Problem	A customer wants to select a product that is *inexpensive*, *good quality*, and with *good service*. Choices have been narrowed down to three products with following utility values:

Product	Price	Quality	Service	Overall Rating
P_1	0.4	0.3	0.8	?
P_2	0.1	0.6	0.5	?
P_3	0.6	0.4	0.3	?

Multi-Criteria Decision Making

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? *Which is the best product*

Aggregation Functions — WAM

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Weights	0.5	0.25	0.25	

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P_1 $0.5(0.4)+0.25(0.3)+0.25(0.8)=0.475$

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Product	Price	Quality	Service	Overall Rating
P_1	0.4	0.3	0.8	0.475
P_2	0.1	0.6	0.5	?
P_3	0.6	0.4	0.3	
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- Weighted Arithmetic Mean

P_1 $0.5(0.4)+0.25(0.3)+0.25(0.8)=0.475$
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P_2	0.1	0.6	0.5	0.325
P_3	0.6	0.4	0.3	?
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P_1 $0.5(0.4)+0.25(0.3)+0.25(0.8)=0.475$
P_2 $0.5(0.1)+0.25(0.6)+0.25(0.5)=0.325$
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P_3	0.6	0.4	0.3	0.950
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Fuzzy Measure

Definition	A *fuzzy measure* is a set of functions $v : 2^N \rightarrow [0,1]$ on all possible combinations of n criteria, which satisifies: ■ $v(A) \leq v(B)$ whenever $A \subset B$; ■ $v(\emptyset) = 0$ and $v(N) = 1$.

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■ Since $A \subseteq N$ is a *coalition* of criteria, $v(A)$ represents the importance of this coalition.

Choquet Integral — Summary

- The Choquet Integral generalises many important aggregation functions including the *mean*, *weighted arithmetic mean*, *maximum*, *minimum* and *ordered weighted average*.
  - Unlike WAM which allocates a weight to each input, it assigns a weight to all the subsets of inputs, hence 2^n parameters.
- *K-Additivity*: k-additive fuzzy measures model no interaction of groups with more than k criteria
  - It allows an arbitrary reduction in complexity at the expense of modelling ability.
  - In the case of 3-addivitity, we can model the interactions of pairs and triples, but not of larger groups.

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Application and Analysis

Data Collection

Source *Tripadvisor* website (`www.tripadvisor.com`)
Extractor *Visual Web Ripper*
Data

- 8561 records about ratings on *Singapore* hotel *features* and overall *ratings*;
- *Demographic*, *Region*, *Travel Types*, etc

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Travel Type	Region	Size
Business	Asia	1210 instances
	Europe	581 instances
	North America	407 instances
	Oceania	381 instances
Couple	Asia	1169 instances
	Europe	1389 instances
	North America	320 instances
	Oceania	1188 instances
Family	Asia	951 instances
	Europe	309 instances
	North America	131 instances
	Oceania	525 instances
	Total:	**8561** instances

Model Evaluation

- *Choquet Integral* is evaluated against typical aggregation methods such as AM, WAM and OWA;

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- Evaluation using the *mean absolute error* (MAE) based on 10-fold cross validation.

Algorithms		Data Sets: Business	Couple	Family
AM		0.0757	0.0689	0.0706
OWA		0.0718	0.0666	0.0682
WAM		0.0701	0.0633	0.0665
CI	$kadd = 1$	0.0701	0.0633	0.0665
	$kadd = 2$	0.0661	0.0614	0.0646
	$kadd = 3$	0.0618	0.0556	0.0611
	$kadd = 4$	0.0619	0.0561	0.0620
	$kadd = 5$	0.0579	0.0541	0.0598
	$kadd = 6$	0.0576	0.0540	0.0591

Conclusion

Related Resources

[1] Gang Li, Rob Law, Huy Quan Vu, Jia Rong. Discovering the Hotel Selection Preferences of Hong Kong Inbound Travelers Using the Choquet Integral, *Tourism Management*, Accepted on 21/10/2012 [1]

[2] Huy Quan Vu, Gleb Beliakov, Gang Li. A Choquet Ingtegral Toolbox and its Application in Customer's Preference Analysis, in *Data Mining Applications with R*, Book Chapter, *Elsevier* 2013 [2] [3]

[1] An extensive invesigation on *HK* hotels preferences.
[2] RFMTool usage and a case study on *Singapore* hotels preferences.
[3] RFMTool: A R toolbox package publically available at TULIP Portal: `http://www.tulip.org.au/resources/rfmtool`

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Questions?

Contact Information

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