

Expert Judgement to Enhance Health Decision Making Malta, 7-9 Oct. 2015

#### Recent advances in multiple criteria decision making: applying the aggregation-disaggregation theory in healthcare

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# Overcrowding effects

- Increased waiting times
- Patients drop out
- Critical treatment delays
- Care quality reduction

#### FlowChart of the Emergency Department



#### Multiple Criteria Perspective

- Waiting time
- Length of stay
- Doctors' working load
- Nurses' working load
- Beds Utilization

# Simulation (SIMU8 layout)



# Typical input

	Waiting Time	<b>Doctors' Load</b>	Utilization
Scenario 1	50 min	70%	80%
Scenario 2	70 min	64%	71%
Scenario 3	45 min	86%	92%

## Then the expert comes

	Waiting Time	Doctors' Load	Utilization
Scenario 1	50 min	70%	80%
Scenario 2	70 min	64%	71%
Scenario 3	45 min	86%	92%

## Then the expert comes

	Waiting Time	Doctors' Load	Utilization	Ranking
Scenario 1	50 min	70%	80%	1
Scenario 2	70 min	64%	71%	2
Scenario 3	45 min	86%	92%	2

## What we expect

- Assess the DM's preference model
- Measure the consistency between the assessed preference model and the a priori preferences of the DM,
- Assess values (values, weights, utilities, ....), and
- Evaluate potential actions (extrapolation output)

# UTA principles (1)

 $\begin{cases} u \left[ \mathbf{g} \left( a \right) \right] > u \left[ \mathbf{g} \left( b \right) \right] \Leftrightarrow a \succ b & \text{(preference)} \\ u \left[ \mathbf{g} \left( a \right) \right] = u \left[ \mathbf{g} \left( b \right) \right] \Leftrightarrow a \sim b & \text{(indifference)} \end{cases} \end{cases}$ 

$$u(\mathbf{g}(a)) = \sum_{i=1}^{n} u_i [g_i(a)] - \sigma^+(a) + \sigma^-(a)$$

 $\Delta(a_k, a_{k+1}) = u[\mathbf{g}(a_k)] - \sigma^+(a_k) + \sigma^-(a_k) - u[\mathbf{g}(a_{k+1})] - \sigma^+(a_{k+1}) + \sigma^-(a_{k+1})$ 

# UTA principles (2)

$$\min z = \sum_{k=1}^{m} \left[ \sigma^{+} (a_{k}) + \sigma^{-} (a_{k}) \right]$$

s.t.

$$\begin{cases} \Delta(a_k, a_{k+1}) \ge \delta & \text{if } \alpha_{\kappa} \succ a_{k+1} \\ \Delta(a_k, a_{k+1}) = 0 & \text{if } \alpha_{\kappa} \sim a_{k+1} \end{cases}, \forall k$$

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#### The disaggregationaggregation approach



## What's the catch?

	Waiting Time	Doctors' Load	Utilization	Ranking
Scenario 1	50 min	70%	80%	1
Scenario 2	70 min	64%	71%	2
Scenario 3	45 min	86%	92%	2

## What's the catch?



$$\mathsf{Stc}^{u(\mathbf{d}^a)} = \sum_{i=1}^n \sum_{j=1}^{\alpha_i} d_i^a(g_i^j) u_i(g_i^j)$$
(8.33)

$$u(\mathbf{d}^{a}) = \sum_{i=1}^{n} \sum_{j=1}^{\alpha_{i}} d_{i}^{aj} \left( \mathbf{y}_{i}^{j} \mathbf{g}_{j}^{j} \right) u_{i} \left( g_{i}^{j} \right)$$
$$u(\mathbf{d}^{a}) \qquad a$$

 $d_{i}\left(g_{i}^{j}\right)$  $u_i\left(g_i^j\right)$  $d_i^a$  $d_i^b$ evaluation scale  ${\cal G}_i$  $g_i^j$ 

# New typical input

	١	Vaiting (mi	ı Time n)		Length of Stay (min)		Doct	ors Wo Load (%)	rking	Nur	ses Wo Load (%)	orking		Beds (%	Jsage 6)		
	0-20	20-40	40-60	60-80	0-100	100-200	200-300	0-33	33-66	66-100	0-33	33-66	66-100	0-25	25-50	50-75	75-100
	10	30	50	70	50	150	250	16,5	50	83,5	16, 5	50	83,5	12,5	37,5	62,5	87,5
Scenario 1	96.9	3.1	0.0	0.0	35.0	62.3	2.8	28.4	71.6	0.0	0	100	0	37.7	29.6	32.7	0.0
Scenario 2	97.2	2.8	0	0	66.1	29.8	4.1	38.5	61.5	0	0	100	0	40	52.6	7.4	0
Scenario 3	53.7	42.9	3.4	0.1	33.3	61.8	4.9	37.5	13.8	48.7	0	100	0	30.7	30.3	39.1	0
Scenario 4	86.3	13.4	0.4	0	35.9	63.9	0.2	28.4	22	49.6	0	98.9	1.1	39.3	36.3 2	24.4	0
Scenario 5	94.1	5.8	0.1	0	93.4	6.6	0	50	50	0	50	50	0	55.5	26.2	18.3	0
Scenario 6	93.4	6.5	0.1	0	89.1	10.9	0	48	8.6	43.4	50	50	0	60	27.6	13.3	0
Scenario 7	71.6	25.7	2.4	0.2	66.7	33.3	0	28.5	23.1	48.5	50	49.6	0.4	59.9	20.2	19.9	0

#### A prototype

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## Scenaria Evaluation

Scenarios	DM	UTA*	Utility
Scenario 1	7	7	0.486
Scenario 2	6	6	0.506
Scenario 3	5	5	0.526
Scenario 4	4	4	0.557
Scenario 5	2	2	0.673
Scenario 6	1	1	0.727
Scenario 7	3	3	0.651

# Criteria Weights





#### Utility Function: Waiting Time





#### MED-UTA: An integrated methodology



#### Future Works - Multiple Experts



#### Future Work - Process Mining







#### Future Work - Balanced Scorecard



#### Future Work - Balanced Scorecard



Thank you!