

# Urban Sustainability Assessment

MCDA Summer School 2018, Chania



## Group 4

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# Background

- United nations have set Sustainable Development Goals (SDGs)
- SDGs are being promoted as the global goals for sustainable development to be reached by 2030
  - 17 SDGs
  - 169 targets



# SDG 11: Sustainable cities & communities

## Sustainable Development Goals



SDGS ICONS DOWNLOAD AND GUIDELINES



# Object of the decision

**Decision maker:** United Nations

**Problem statement:** complete ranking of the cities

As the SDG's are set to be reached in 2030, the UN is willing to give additional funding in 2019 to those cities that perform the worst based on the targets as indicated by SDG 11. They have asked us to provide this ranking.



# Criteria related to SDG 11

Target	Descriptions	Indicators
11.1	By 2030, ensure access to education	Education
11.1	By 2030 ensure access to basic services	Internet access
11.5	By 2030 reduce the number of diseases in the city	Doctors resource
11.2	By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, by expanding public transport	Mass transit usage
11.6	By 2030, reduce the adverse per capita environmental impact of cities, by paying special attention to municipal and other waste management	Household waste management
11.6	By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality	Air pollution
11.7	By 2030, provide universal access to safe, inclusive and accessible, green and public spaces	Public green space
1.1	By 2030, eradicate extreme poverty for all people in the city, currently measured as people living on less than \$1.25 a day	Employment share
9.5	Enhance scientific research, upgrade the technological capabilities including, by 2030, encouraging innovation	R&D investment
1.1	By 2030, eradicate extreme poverty for all people in the city, currently measured as people living on less than \$1.25 a day	Income level



# Elicitation of preferences

- DM was not available → indirect preference elicitation
- Based on ranking of subset of 4/12 cities by Arcadis Sustainable Cities Index 2016
  - Overall ranking
- Different approaches used for preference elicitation:
  1. Elicitation decision rules (jMAF)
  2. UTA
  3. Choquet (diviz)



# Arcadis Sustainable Cities Index



People		Planet		Profit		Overall	
Seoul	76.2	Stockholm	87.1	Hong Kong	80.3	Stockholm	73.9
Berlin	71	London	76.5	London	80.1	London	73.2
Prague	70.8	Copenhagen	74.8	Prague	69.3	Seoul	69.6
Stockholm	67.7	Berlin	73	New York	69.3	Prague	69.1
Paris	67.3	Seoul	69.7	Paris	68.6	Copenhagen	68
Copenhagen	66.3	Hong Kong	67.9	Stockholm	66.9	Paris	67.6
London	63.1	Prague	67.2	Copenhagen	63	Hong Kong	66.8
Shanghai	60.8	Paris	66.8	Seoul	62.9	Berlin	66.7
Tokyo	60.1	New York	66.1	Tokyo	56.8	New York	62.9
Beijing	60	Tokyo	60.4	Berlin	56.1	Tokyo	59.1
New York	53.4	Shanghai	42.8	Beijing	45.3	Beijing	47.1
Hong Kong	52.3	Beijing	36	Shanghai	36.5	Shanghai	46.7





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# 1. Decision rules: results

Chania_2018\Chania_Rules_4.rules X					
ID	Decision	<=	Condition 1		Condition 2
1	x S y	<=	(diff_XV >= 0.26)		
2	x S y	<=	(diff_XII >= 0.0)	&	(diff_XV >= 0.0)
3	x S y	<=	(diff_XII >= 0.07)	&	(diff_XV >= -0.2)
4	x Sc y	<=	(diff_XV <= -0.26)		
5	x Sc y	<=	(diff_XII <= 0.0)	&	(diff_XV <= -0.12)
6	x Sc y	<=	(diff_XII <= -0.07)	&	(diff_XV <= 0.2)

- 8 indicators
- 6 rules
- Only indicators public green space & household waste management seem to matter

Chania_2018\Chania_Rules_4.rules X					
ID	Decision	<=	Condition 1		Condition 2
1	x S y	<=	(diff_VIII <= -0.01)		
2	x S y	<=	(diff_VIII <= 0.0)	&	(diff_XIV >= 0.0)
3	x Sc y	<=	(diff_VIII >= 0.01)		
4	x Sc y	<=	(diff_XIV <= -582.6)		

- 10 indicators
- 4 rules
- Different indicators mattered (Air pollution & Public transport usage)
- Not robust



## 2. Ranking using UTA

- Method used: UTA
  - Using diviz
  - Preference elicitation using ACUTA
  - General weighted Sum
- Preference elicitation based on overall ranking by Arcadis

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# Results based on overall Arcadis ranking

Ranking	Value functions with 2 segments	Value functions with 3 segments	Value functions with 4 segments
1	Best	Best	Best
2	Stockholm	Stockholm	Stockholm
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4	London	London	Berlin
5	Berlin	Berlin	London
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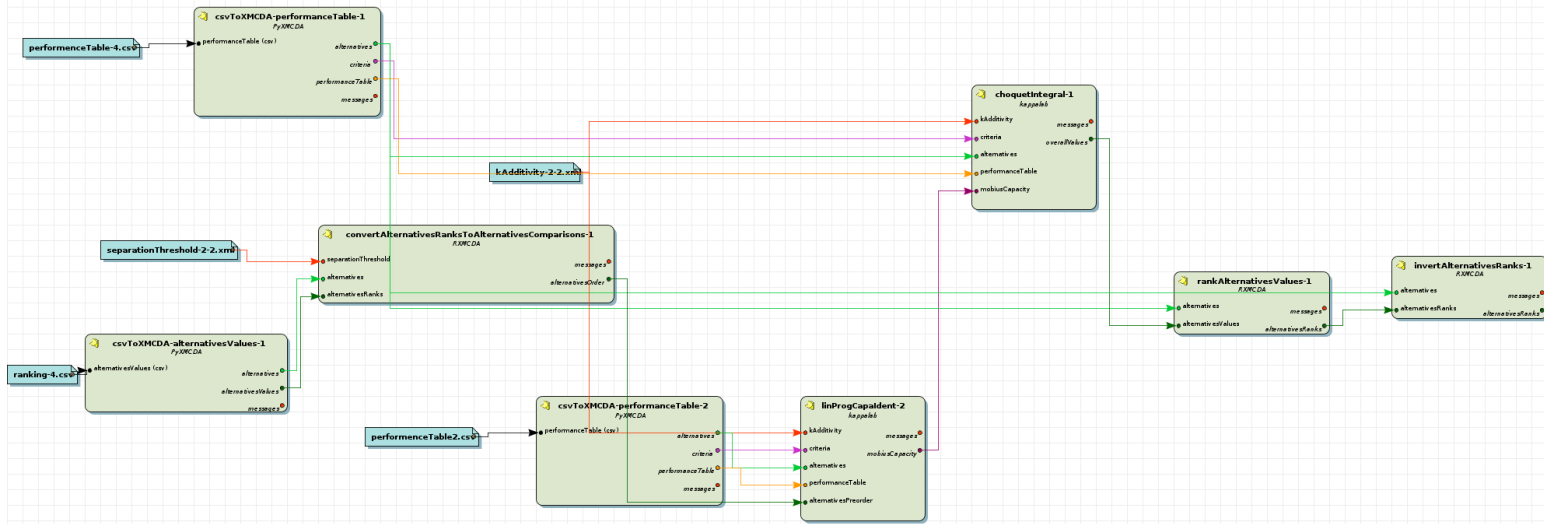


# 3. Choquet

- Used overall Arcadis evaluation again
- Using Choquet in order to find whether there is interaction between the indicators
- Most of the indicators had very small interactions
- However, we did find interaction between
  - Public transport, R&D and internet access



# 3. Workflow Choquet



# Ranking based on Choquet compared to the UTA ranking

	UTA 2 segments	UTA 3 segments	UTA 4 segments		Ranking based on Choquet
1	Best	Best	Best	1	Tokyo
2	Stockholm	Stockholm	Stockholm	2	Stockholm
3	Copenhagen	Copenhagen	Copenhagen	3	Shanghai
4	London	London	Berlin	4	London
5	Berlin	Berlin	London	5	Beijing
6	Beijing	Beijing	Beijing	6	New York
7	Seoul	Tokyo	Tokyo	7	Paris
8	Paris	Paris	Paris	8	Copenhagen
9	Tokyo	Seoul	Seoul	9	Seoul
10	Prague	Prague	Prague	10	Hong Kong
11	New York	New York	New York	11	Berlin
12	Shanghai	Shanghai	Shanghai	12	Prague
13	Hong Kong	Hong Kong	Hong Kong		
14	Last	Last	Last		



# Choquet

- Suggest to the DM that instead of looking for interactions between indicators (too many), we would have rather looked for interactions between the three pillars
  - Less indicators per pillar, more useful to look for interactions
- However, this is not possible based on the current Arcadis evaluation.



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# Preference elicitation for economic pillar is not possible based on Arcadis evaluation

Arcadis evaluation based on economic pillar		Employment share	Income per urban capita	Government investment in R&D
1	London	0,514	33,052	405
2	Prague	0,515	14,2	538,35
3	Stockholm	0,52	30,5	480
4	Seoul	0,623	32,791	0

## Arcadis indicators for economic sustainability:

- Profit Transport infrastructure
- Ease of doing business
- Tourism
- GDP per capita
- The city's importance in global economic networks
- Internet connectivity
- Employment rates

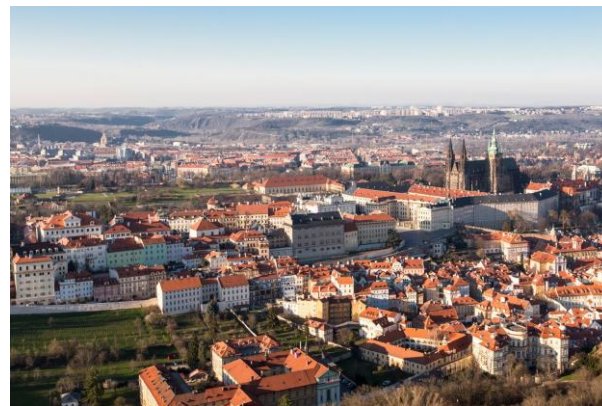


# Conclusions

- Hong Kong and Prague seem to be the worst performing cities on overall Urban Sustainability
- However, we would like to ask the DM for other economic indicators in order to make a more robust ranking possible.
  - Need more time and resources 😊



Hong Kong



Prague





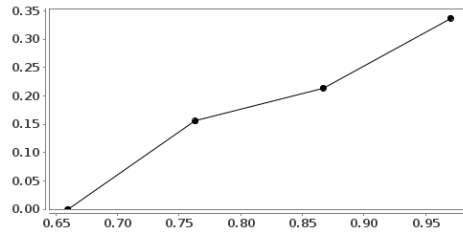
# Thank you!



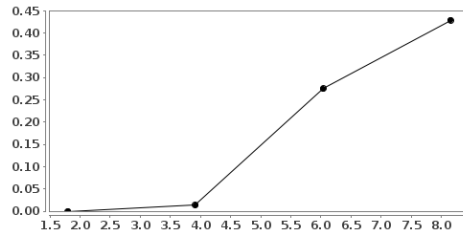
# Value functions

## Social

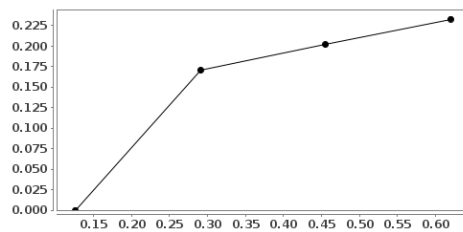
**Internet**



**Doctor**

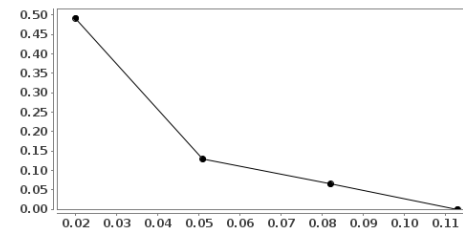


**school**

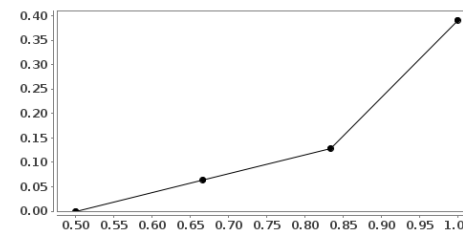


## Environmental

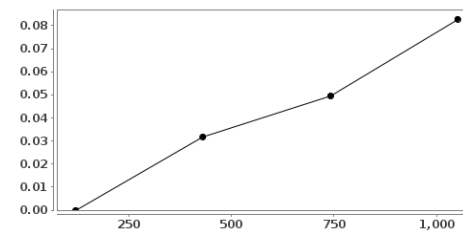
**PM10**



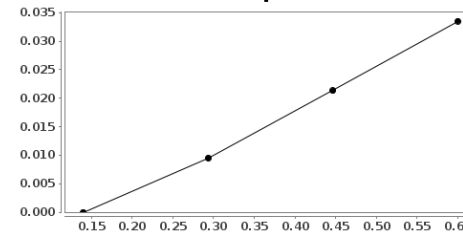
**waste**



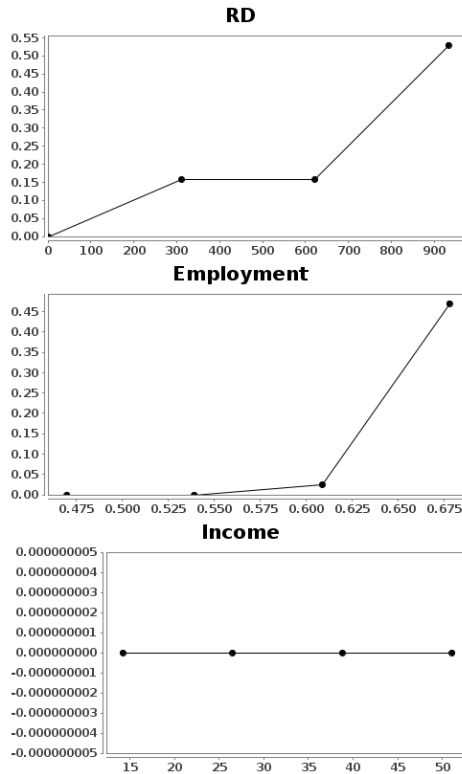
**Passengers**



**GreenSpace**



# Value functions: economic



- Evaluations for environmental & social pillars give usable value functions
- However, for the economic pillar the used evaluation and indicators do not provide usable value functions
- Why?

