Quick reminder	Objectives update	New developments	Demo	What's next?

Integration of ELECTRE TRI in a GIS Coupling with a XMCDA webservice for inference

Olivier Sobrie

University of Mons Faculty of engineering

April 13, 2010

<u>U</u>MONS

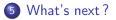
◆□▶ ◆□▶ ◆□▶ ◆□▶ ● ● ●

Quick reminder	Objectives update	New developments	Demo	What's next?

1 Quick reminder

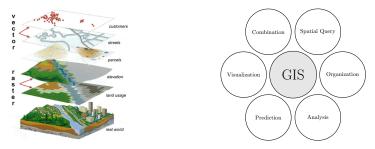
- Objectives update
- 3 New developments

4 Demo





Quick reminder •••••	Objectives update	New developments	Demo	What's next?
GIS and MC	CDA			



- GIS are used in lot of application from land suitability problem to geomarketing
- Since 90's, works about GIS and MCDA
- Not a lot of work based on ELECTRE methods
- ELECTRE methods fit well for ordinal problems

Quick reminder o●ooooo	Objectives update	New developments	Demo	What's next?
GIS and M	CDA			

◆□▶ ◆□▶ ◆□▶ ◆□▶ ● ● ●

Limitations of GIS-MCDA works according to S. Chakhar :

- Weak coupling
- One MCDA method integrated
- Choice of the MCDA method
- Single criterion synthesis
- User's knowledge of SIG and MCDA

Quick reminder o●ooooo	Objectives update	New developments	Demo	What's next?
GIS and M	CDA			

Limitations of GIS-MCDA works according to S. Chakhar :

- Weak coupling
- One MCDA method integrated
- Choice of the MCDA method
- Single criterion synthesis
- User's knowledge of SIG and MCDA

We add an extra one :

A good number of GIS-MCDA tools were abandoned or never surpassed the stage of prototype

ション ふゆ く 山 マ チャット しょうくしゃ

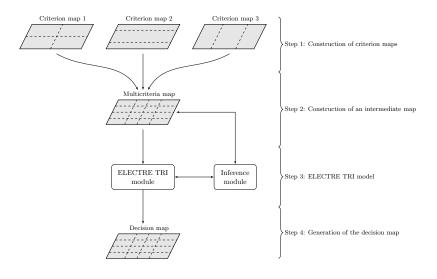
Quick reminder ○○●○○○○	Objectives update	New developments	Demo	What's next?
Objectives of	our GIS-MCD	A integration		

- ELECTRE TRI implementation
- Tight coupling
- User friendly interface
- Open Source GIS (and implementation)
- Support for standard and Bouyssou-Marchant methodology

◆□▶ ◆□▶ ◆□▶ ◆□▶ ● ● ●

Quick reminder	Objectives update	New developments	Demo	What's next?
Stratomy to 1	wild the decid	ion mon		

Strategy to build the decision map



Quick reminder	Objectives update	New developments	Demo	What's next?
Status at the	e previous work	shop		

	Quantum GIS 1.5.0-Tethys	
Ele Edit View Layer Plugins Vector CadTools Help		
	😫 🔗 😢 🔍 🧠 🚍 🥁 🚍 🖆 💭 🈿 🔦 🕮 🚺	
2 = 4 \$\$ 0 \$\$ 0 \$\$ 0 \$\$	b O S O S I A A O C 🚰 II 😘 TI 🏠 Z	🏠 % 🐝 🐍 🏁 🖬
🗖 🖉 📾 🖬 🕂 🕂 🖫 🍌		
Layers 0	500,000	
🔹 🖬 🕞 france	MainWindow	
· · · · · · · · · · · · · · · · · · ·	Criterions Profiles	
	Criteria Weight	
		Input Layer
		france - Load
		Profiles
		->> Add Profile
		->> Del Profile
		->> Del Profile
		Thresholds
		 Use same for all profiles
		No Veto
		Indifference = Preference
		Affectation
		Cutting level: 0.75
		Procedure: Pessimist +
		->> Generate Decision Map
		has a second
		-1
	S Coordinate:	-266584,6936474 Scale [1:850539086415 👩 🗹 Render 🔯

▲□▶ ▲□▶ ▲□▶ ▲□▶ ▲□ ● ④�?

Quick reminder ○○○○○●○	Objectives update	New developments	Demo	What's next?
Demo · Deno	sification of Q	uebec city		

Subject

Quebec city wants to create a program to densify its population in the centrum and around the small crown. The program consists to build rental properties at low prices for young families in empty areas.

Objectives

- Densify central sectors where the there are more public transports
- Sustain a good social diversity by choosing in priority the sectors where young people and immigrants are not well represented
- Favor sectors with a lot of small shops

Quick reminder ○○○○○○●	Objectives update	New developments	Demo	What's next?
Demo : Dens	ification of Q	uebec city		

Actions

786 actions (polygons)

Criteria

- Density of 0-14 years old [%] (min)
- Density of shops [shops/ha] (max)
- Density of people [residents/ha] (min)
- Level of public transports (average) [bus/hour] (max)
- Ratio of immigrants [%] (min)

Categories

- 1. Bad
- 2. Medium
- 3. Good

Quick reminder	Objectives update	New developments	Demo	What's next?
Objectives	update			

Save/Load parameters

Add the possibility to save an XMCDA model and restore it in the plugin

XMCDA webservice for parameters inference

- Create a new webservice to infer parameters of the ELECTRE TRI model globaly and partialy
- Make some experiments

Coupling the webservice with our ELECTRE TRI plugin

Create user-friendly interface to use the webservice with our Quantum GIS plugin

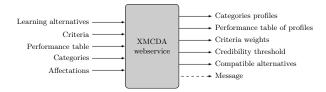
Quick reminder

Save/Load parameters

			EI	ectre Tri		
riteria	Profiles	Inference				
	C11	C412	C310	C411	C39	
	1.0	2.0	1.0	1.0	1.0	XMCDA
2	2.0	2.0	2.0	2.0	3.0	Load parameters
3	2.0	3.0	3.0	2.0	3.0	Save parameters
Indiffer	ance Pro	ference Veto	1		•	Categories 4 \bigcirc
	c11	C412	C310	C411	C39	Thresholds
1	0.0	0.0	0.0	0.0	0.0	Use same for all profiles
2	0.0	0.0	0.0	0.0	0.0	Indifference = Preference
з	0.0	0.0	0.0	0.0	0.0	Affectation
•		m			Þ	Cutting level: 0.76

・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・
 ・

Quick reminder	Objectives update	New developments	Demo	What's next?
FLECTRE .	TRI RM infere	nce webservice		



Characteristics

- Bouyssou-Marchant ELECTRE TRI model
- Accept non-admissible set of learning alternatives
- Maximize number of compatible alternatives
- MIP problem
- Use GLPK

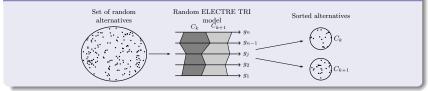
 Quick reminder
 Objectives update
 New developments
 Demo
 What's next?

 ELECTRE TRI BM inference experimentations

 Methodology

Similar methodology as the one used by Agnès Leroy in her thesis

Step 1 : Generate random data



◆□▶ ◆□▶ ★□▶ ★□▶ □ のQ@

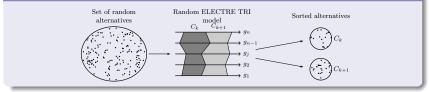
 Quick reminder
 Objectives update
 New developments
 Demo
 What's next?

 ELECTRE TRI BM inference experimentations

 Methodology

Similar methodology as the one used by Agnès Leroy in her thesis

Step 1 : Generate random data



Step 2 : Pick learning alternatives

Step 3 : Inference of ELECTRE TRI model

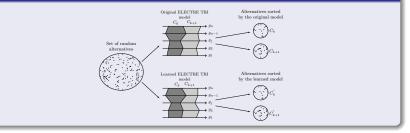




Step 3 : Inference of ELECTRE TRI model



Step 4 : Analysis of learning model

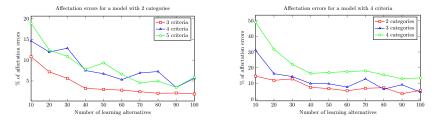


▲ロト ▲圖ト ▲ヨト ▲ヨト 三ヨー のへで

 Quick reminder
 Objectives update
 New developments
 Demo
 What's next?

 CODO-OCODODOO
 CODO-OCODODOO
 CODO
 CODO
 CODO
 CODO

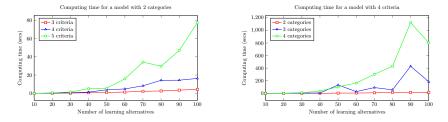
 ELECTRE TRI BM inference experimentations
 Results - Affectation errors
 CODO
 CODO
 CODO
 CODO



Remarks

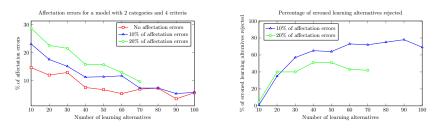
- ▶ Number of criteria \nearrow \Rightarrow Affectation error \nearrow
- ▶ Number of categories \nearrow \Rightarrow Affectation error \nearrow
- Number of learning alt. $\nearrow \Rightarrow$ Affectation error \searrow





Remarks

- ▶ Number of criteria \nearrow \Rightarrow Computing time \nearrow
- ▶ Number of categories \nearrow \Rightarrow Computing time \nearrow
- ▶ Number of learning alt. \nearrow \Rightarrow Computing time \nearrow \nearrow



Remarks

- ▶ Number of erroned learn. alt. \nearrow ⇒ Affectation errors \nearrow
- ▶ Number of learning alt. ↗
- ► Number of learning alt. ↗

 \Rightarrow Affectation errors \checkmark

 Quick reminder
 Objectives update
 New developments
 Demo
 What's next?

 OCODOCO
 OCODOCO
 OCODOCO
 OCO
 OCO

 ELECTRE TRI BM inference experimentations
 First conclusions and ideas for improvement
 OCO

First conclusions

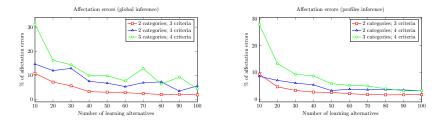
- Lot of learning alternatives needed to get good results
- With errors in the learning set, more alternatives are needed
- Computing become huge when number of learning alternatives increase

◆□▶ ◆□▶ ◆□▶ ◆□▶ □ のQ@

Ideas for improvement

- Two step inference
- Improve objective of the inference program
- Partial inference

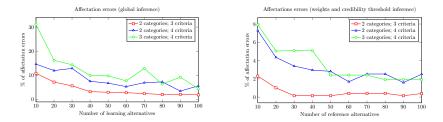




Remarks

- Less alternatives needed to get good results
- Less computing time needed than for global inference
- Generaly better than global inference for the same number of learning alternatives

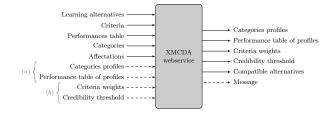




Remarks

- Less alternatives needed to get good results
- Less computing time needed than for global inference
- Generaly better than profiles inference for the same number of learning alternatives

Quick reminder	Objectives update	New developments ○○○○○○○○○	Demo	What's next?
ELECTRE T	RI BM inferenc	ce webservice ı	update	



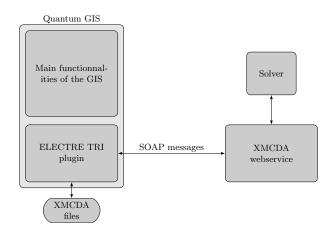
Characteristics

- Two entries added to do partial inference of the weights and lambda threshold
- Two entries added to do partial inference of the profiles

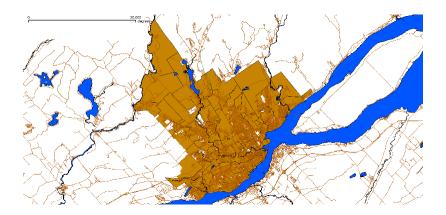
 Quick reminder
 Objectives update
 New developments
 Demo
 What's next?

 Coupling of XMCDA webservice with Quantum GIS

 ELECTRE TRI plugin

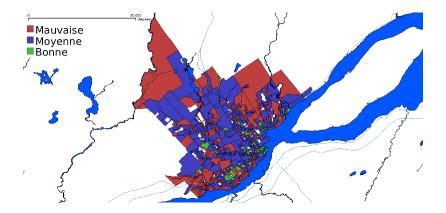


Quick reminder	Objectives update	New developments	Demo	What's next?
It's time for	a demo			

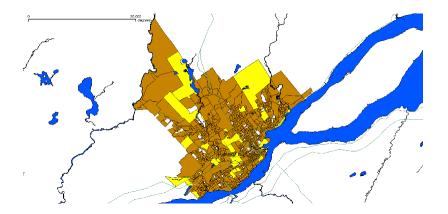


▲□▶ ▲圖▶ ▲≣▶ ▲≣▶ = 三 - 釣�?

Quick reminder	Objectives update	New developments	Demo	What's next?
Original mo	del			

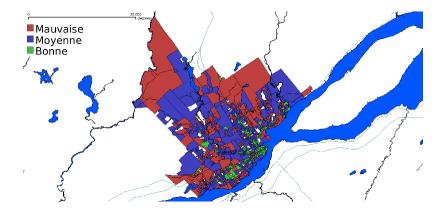


Quick reminder	Objectives update	New developments	Demo	What's next?
Actions of	reference			



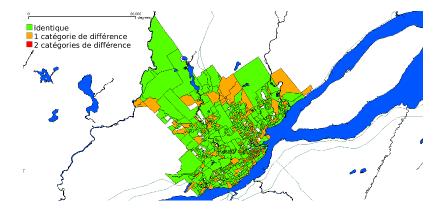
◆□▶ ◆□▶ ◆目▶ ◆目▶ ◆□▼

Quick reminder	Objectives update	New developments	Demo	What's next?
Global infere	nce			



Quick reminder	Objectives update	New developments	Demo	What's next?
Clobal infor	nco (difforanc	\sim		

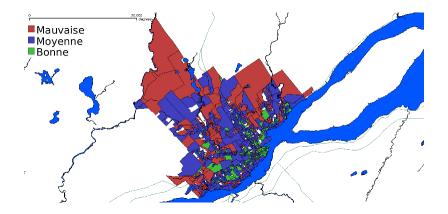




<ロ> (四) (四) (三) (三) (三) (三)

 \pm 29% of invalid affectations

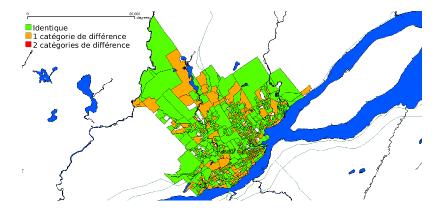
Quick reminder	Objectives update	New developments	Demo	What's next?
Profiles infer	ence			



▲ロト ▲舂 ▶ ▲ 恵 ▶ ▲ 恵 ▶ ● 恵 ● のへで

Quick reminder	Objectives update	New developments	Demo	What's next?
Profiles inf	oronco (difforon	(\mathbf{c})		

(unterence) CI. ICC.



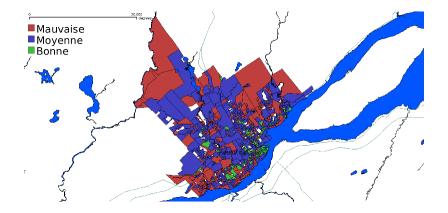
・ロト ・個ト ・ヨト ・ヨト

æ

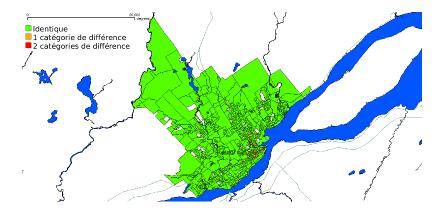
 \pm 33% of invalid affectations

Quick reminder	Objectives update	New developments	Demo	What's next?

Weights and lambda inference



Quick reminder	Objectives update	New developments	Demo	What's next?
Weights and	lambda infere	nce (difference))	



メロト メポト メヨト メヨト 三日

 \pm 6% of invalid affectations

Nove dovelop				
Quick reminder	Objectives update	New developments	Demo	What's next? ●○○

Next developments and ideas...

Plugin improvement

- Add plot of the profiles
- Add the possibility to choose a spatial entity by clicking on it in the inference module

Coupling with IRIS webservice

Be able to perform ELECTRE TRI inference with the IRIS webservice

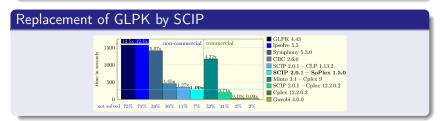
Smart selection of spatial entities for inference

Add a button to select by default an optimal set of spatial entities to use as learning alternatives with the inference program

Quick reminder	Objectives update	New developments	Demo	What's next? ○●○
To discuss				

Webservice compatibility

Currently it is not possible to connect the inference webservice with the ELECTRE TRI one



Inclusion of XMCDA functions in PyXMCDA

- Some generic functions included in the Quantum GIS ELECTRE TRI plugin might be integrated in the PyXMCDA library
- Ixml module?

Quick reminder

◆□▶ ◆□▶ ★□▶ ★□▶ □ のQ@

Thank you for your attention !