Educational activities and PhD study

MAP final stakeholder workshop, 15 Dec 2020

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Education activities related to MAP

Implement MAP related materials for master level courses in Oulu Mining School

1) Lectures in course 'Regional ore geology of Fennoscandia', emphasizing on modeling result in Finland

- Fennoscandia is the most active region in EU for both mining and exploration
- Orogenic gold deposits, VMS deposits, PGE deposits
- In future, could potentially use the results of testing workshops as examples
- Kalevi Rasilainen and Vesa Nykänen had the lectures in 2019. In 2020, mainly by OMS

2) Lecture in course 'Project generation for exploration targeting', emphasizing on methodology (video lectures, online course)

- Introduction of different exploration technique first
- How to combine different exploration data, mineral prospective modeling (e.g., Fuzzy logic modelling)
- Three part method to evaluate the undiscovered mineral resource
- Assessment procedure, self exercise (MPM online tool)
- ➢ Deliverable O 6.1, 6.2

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3) Practicals in another course 'Magmatic ore deposits'

- One lecture is about magmatic Ni-Cu sulfide deposits

- As an exercise, asking the student to do prospective modelling using different exploration data

- Using the same video lectures previously recorded, share online, with a short instruction

4) Similar exercise in a summer school 'Arctic mining' (128 bachelor students)
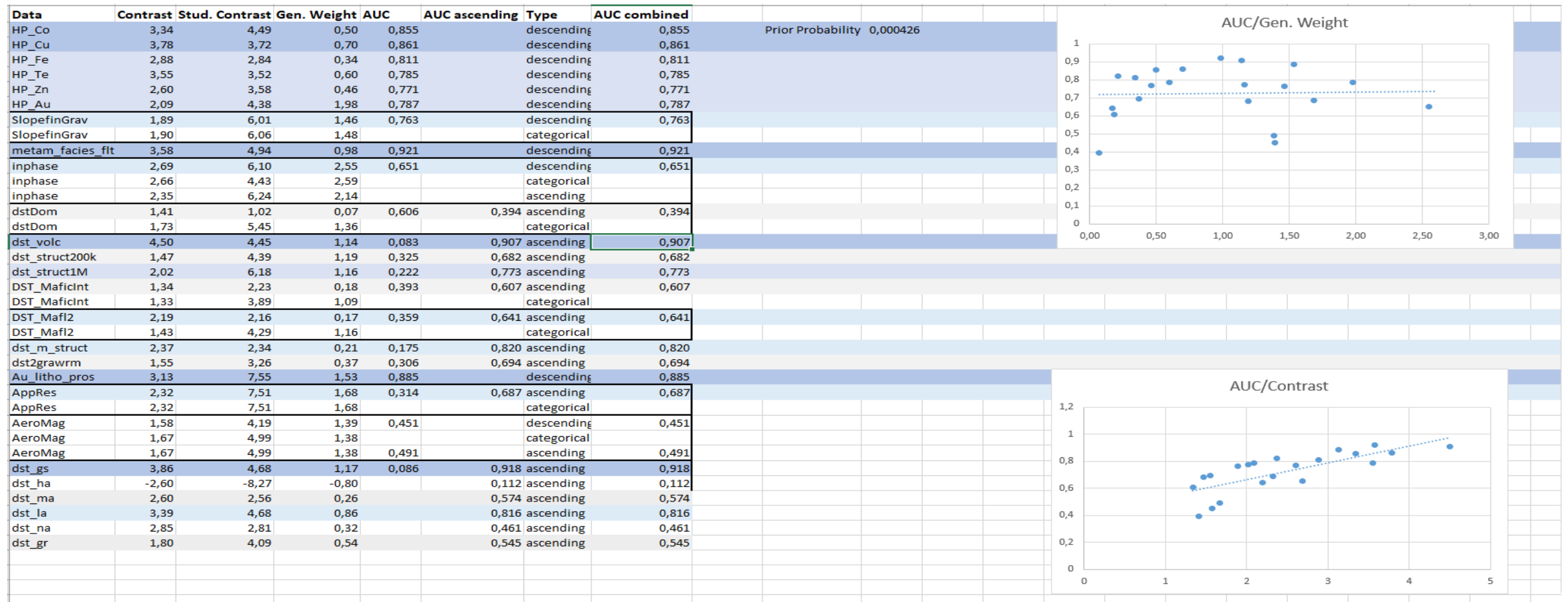
5) Future

- MAP related materials can be delivered to students via lectures or exercises in different courses, as mentioned above

- Using the final version of MAP wizard, installation in university computers in advance, and testing data from partners

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PhD thesis study plan

Andreas Nuspl *(University of Oulu / GTK)*

Research team: Shenghong Yang (*University of Oulu*),Vesa Nykänen, Kalevi Rasilainen, Johanna Torppa (*GTK*)

- Evaluation of input parameters and verification of the correlability of validation methods (AUC, Weight of Evidence) (August – September 2020)

- Variability of fuzzy membership values in dependency of midpoint and spread (November – December 2020)

- Simulation of more than 3000 fuzzy logic models and simultaneous calculation of AUC values by using the recently developed Fuzzy ROC 2 tool (October – December 2020)

- Determination of crucial parameters yielding high AUC values in the fuzzy logic model (November – December 2020)

- Need several more months in 2021, applied funding from Renlund, to cover salary (application result will be available in middle Feb 2021)

Data	Contrast	Stud. Contrast	Gen. Weight	AUC	AUC ascending	Type	AUC combined
HP_Co	3,34	4,49	0,50	0,855		descending	0,855
HP_Cu	3,78	3,72	0,70	0,861		descending	0,861
HP_Fe	2,88	2,84	0,34	0,811		descending	0,811
HP_Te	3,55	3,52	0,60	0,785		descending	0,785
HP_Zn	2,60	3,58	0,46	0,771		descending	0,771
HP_Au	2,09	4,38	1,98	0,787		descending	0,787
SlopefinGrav	1,89	6,01	1,46	0,763		descending	0,763
SlopefinGrav	1,90	6,06	1,48			categorical	
metam_facies_flt	3,58	4,94	0,98	0,921		descending	0,921
inphase	2,69	6,10	2,55	0,651		descending	0,651
inphase	2,66	4,43	2,59			categorical	
inphase	2,35	6,24	2,14			ascending	
dstDom	1,41	1,02	0,07	0,606	0,394	ascending	0,394
dstDom	1,73	5,45	1,36			categorical	
dst_volc	4,50	4,45	1,14	0,083	0,907	ascending	0,907
dst_struct200k	1,47	4,39	1,19	0,325	0,682	ascending	0,682
dst_struct1M	2,02	6,18	1,16	0,222	0,773	ascending	0,773
DST_MaficInt	1,34	2,23	0,18	0,393	0,607	ascending	0,607
DST_MaficInt	1,33	3,89	1,09			categorical	
DST_Mafl2	2,19	2,16	0,17	0,359	0,641	ascending	0,641
DST_Mafl2	1,43	4,29	1,16			categorical	
dst_m_struct	2,37	2,34	0,21	0,175	0,820	ascending	0,820
dst2grawrm	1,55	3,26	0,37	0,306	0,694	ascending	0,694
Au_litho_pros	3,13	7,55	1,53	0,885		descending	0,885
AppRes	2,32	7,51	1,68	0,314	0,687	ascending	0,687
AppRes	2,32	7,51	1,68			categorical	
AeroMag	1,58	4,19	1,39	0,451		descending	0,451
AeroMag	1,67	4,99	1,38			categorical	
AeroMag	1,67	4,99	1,38	0,491		ascending	0,491
dst_gs	3,86	4,68	1,17	0,086	0,918	ascending	0,918
dst_ha	-2,60	-8,27	-0,80		0,112	ascending	0,112
dst_ma	2,60	2,56	0,26		0,574	ascending	0,574
dst_la	3,39	4,68	0,86		0,816	ascending	0,816
dst_na	2,85	2,81	0,32		0,461	ascending	0,461
dst_gr	1,80	4,09	0,54		0,545	ascending	0,545

Prior Probability 0,000426

AUC/Gen. Weight

AUC/Contrast

Evaluation of input parameters,
Verification of the correlatability of validation methods (ROC, Weight of Evidence)

Variability of fuzzy membership values in dependency of midpoint and spread

Distance to greenschist

ESRI default value
Spread 2, 5 & 8

Median
Spread 2, 5 & 8

Variability of fuzzy membership values in dependency of midpoint and spread
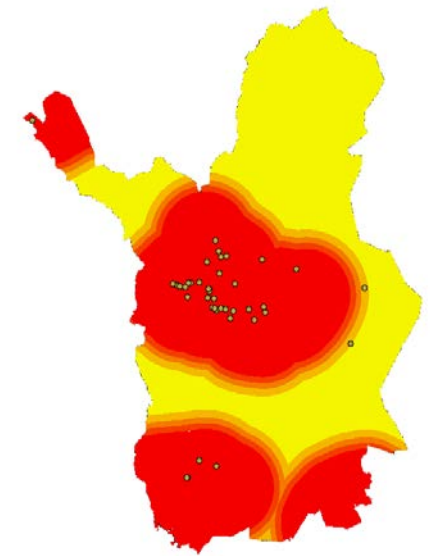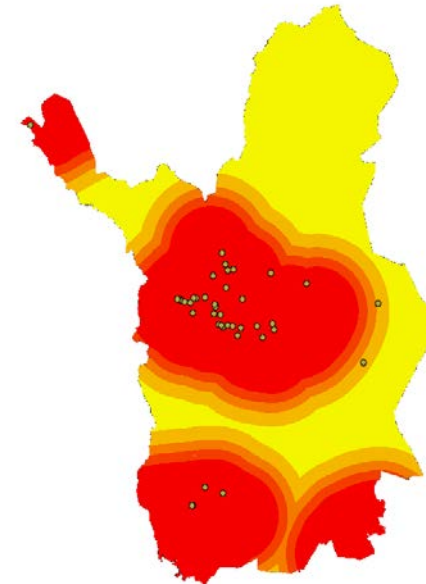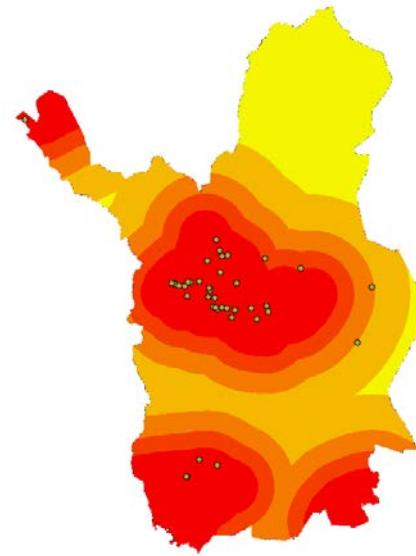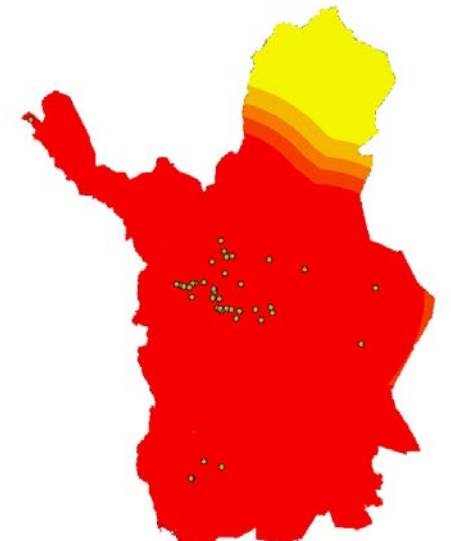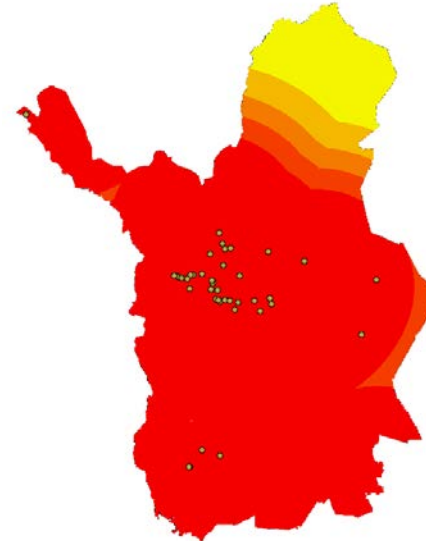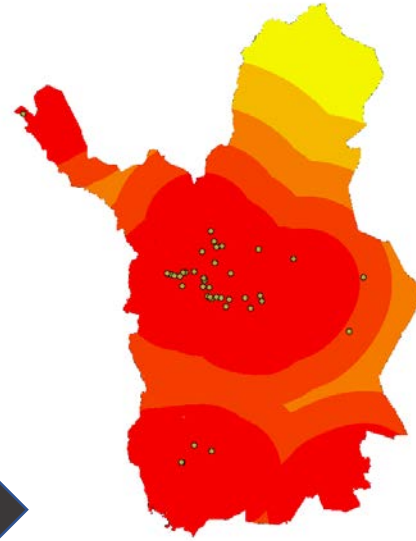
Model	Auc				Output	Input1	Input2	Input3	Input4	Input5		AR Spr. 5	AR Spr. 4	Cu med. 4	Cu med. 5	dst. GS
FO_0	0,832		1		FO_0	FM_0_0	FM_1_0	FM_2_0	FM_3_0	FM_4_0	4	#N/A	#N/A	#N/A	#N/A	0,8
FO_1	0,831		2		FO_1	FM_0_1	FM_1_0	FM_2_0	FM_3_0	FM_4_0	4	#N/A	#N/A	#N/A	#N/A	0,8
FO_2	0,839		3		FO_2	FM_0_2	FM_1_0	FM_2_0	FM_3_0	FM_4_0	4	#N/A	#N/A	#N/A	#N/A	0,8
FO_3	0,840		4		FO_3	FM_0_3	FM_1_0	FM_2_0	FM_3_0	FM_4_0	4	#N/A	#N/A	#N/A	#N/A	0,
FO_4	0,831		5		FO_4	FM_0_0	FM_1_1	FM_2_0	FM_3_0	FM_4_0	4	#N/A	#N/A	#N/A	#N/A	0,8
FO_5	0,830		6		FO_5	FM_0_1	FM_1_1	FM_2_0	FM_3_0	FM_4_0	4	#N/A	#N/A	#N/A	#N/A	0,
FO_6	0,838		7		FO_6	FM_0_2	FM_1_1	FM_2_0	FM_3_0	FM_4_0	4	#N/A	#N/A	#N/A	#N/A	0,8
FO_7	0,840		8		FO_7	FM_0_3	FM_1_1	FM_2_0	FM_3_0	FM_4_0	4	#N/A	#N/A	#N/A	#N/A	0,
FO_8	0,840		9		FO_8	FM_0_0	FM_1_2	FM_2_0	FM_3_0	FM_4_0	5	#N/A	#N/A	#N/A	#N/A	#N/A
FO_9	0,840		10		FO_9	FM_0_1	FM_1_2	FM_2_0	FM_3_0	FM_4_0	5	#N/A	#N/A	#N/A	#N/A	#N/A
FO_10	0,847		11		FO_10	FM_0_2	FM_1_2	FM_2_0	FM_3_0	FM_4_0	5	#N/A	#N/A	#N/A	#N/A	#N/A
FO_11	0,851		12		FO_11	FM_0_3	FM_1_2	FM_2_0	FM_3_0	FM_4_0	5	#N/A	#N/A	#N/A	#N/A	#N/A
FO_12	0,840		13		FO_12	FM_0_0	FM_1_3	FM_2_0	FM_3_0	FM_4_0	6	#N/A	#N/A	#N/A	#N/A	#N/A
FO_13	0,841		14		FO_13	FM_0_1	FM_1_3	FM_2_0	FM_3_0	FM_4_0	6	#N/A	#N/A	#N/A	#N/A	#N/A
FO_14	0,850		15		FO_14	FM_0_2	FM_1_3	FM_2_0	FM_3_0	FM_4_0	6	#N/A	#N/A	#N/A	#N/A	#N/A
FO_15	0,852		16		FO_15	FM_0_3	FM_1_3	FM_2_0	FM_3_0	FM_4_0	6	#N/A	#N/A	#N/A	#N/A	#N/A
FO_16	0,836		17		FO_16	FM_0_0	FM_1_0	FM_2_1	FM_3_0	FM_4_0	4	#N/A	#N/A	#N/A	#N/A	0,8
FO_17	0,834		18		FO_17	FM_0_1	FM_1_0	FM_2_1	FM_3_0	FM_4_0	4	#N/A	#N/A	#N/A	#N/A	0,8
FO_18	0,842		19		FO_18	FM_0_2	FM_1_0	FM_2_1	FM_3_0	FM_4_0	4	#N/A	#N/A	#N/A	#N/A	0,8
FO_19	0,844		20		FO_19	FM_0_3	FM_1_0	FM_2_1	FM_3_0	FM_4_0	4	#N/A	#N/A	#N/A	#N/A	0,8
FO_20	0,835		21		FO_20	FM_0_0	FM_1_1	FM_2_1	FM_3_0	FM_4_0	4	#N/A	#N/A	#N/A	#N/A	0,8
FO_21	0,834		22		FO_21	FM_0_1	FM_1_1	FM_2_1	FM_3_0	FM_4_0	4	#N/A	#N/A	#N/A	#N/A	0,8
FO_22	0,842		23		FO_22	FM_0_2	FM_1_1	FM_2_1	FM_3_0	FM_4_0	4	#N/A	#N/A	#N/A	#N/A	0,8
FO_23	0,844		24		FO_23	FM_0_3	FM_1_1	FM_2_1	FM_3_0	FM_4_0	4	#N/A	#N/A	#N/A	#N/A	0,8
FO_24	0,842		25		FO_24	FM_0_0	FM_1_2	FM_2_1	FM_3_0	FM_4_0	5	#N/A	#N/A	#N/A	#N/A	#N/A
FO_25	0,842		26		FO_25	FM_0_1	FM_1_2	FM_2_1	FM_3_0	FM_4_0	5	#N/A	#N/A	#N/A	#N/A	#N/A
FO_26	0,854		27		FO_26	FM_0_2	FM_1_2	FM_2_1	FM_3_0	FM_4_0	5	#N/A	#N/A	#N/A	#N/A	#N/A
FO_27	0,854		28		FO_27	FM_0_3	FM_1_2	FM_2_1	FM_3_0	FM_4_0	5	#N/A	#N/A	#N/A	#N/A	#N/A
FO_28	0,846		29		FO_28	FM_0_0	FM_1_3	FM_2_1	FM_3_0	FM_4_0	6	#N/A	#N/A	#N/A	#N/A	#N/A
FO_29	0,846		30		FO_29	FM_0_1	FM_1_3	FM_2_1	FM_3_0	FM_4_0	6	#N/A	#N/A	#N/A	#N/A	#N/A
FO_30	0,855		31		FO_30	FM_0_2	FM_1_3	FM_2_1	FM_3_0	FM_4_0	6	#N/A	#N/A	#N/A	#N/A	#N/A
FO_31	0,857		32		FO_31	FM_0_3	FM_1_3	FM_2_1	FM_3_0	FM_4_0	6	#N/A	#N/A	#N/A	#N/A	#N/A
FO_32	0,758		33		FO_32	FM_0_0	FM_1_0	FM_2_2	FM_3_0	FM_4_0	1	#N/A	0,758	#N/A	#N/A	#N/A
FO_33	0,759		34		FO_33	FM_0_1	FM_1_0	FM_2_2	FM_3_0	FM_4_0	1	#N/A	0,759	#N/A	#N/A	#N/A
FO_34	0,771		35		FO_34	FM_0_2	FM_1_0	FM_2_2	FM_3_0	FM_4_0	1	#N/A	0,771	#N/A	#N/A	#N/A
FO_35	0,776		36		FO_35	FM_0_3	FM_1_0	FM_2_2	FM_3_0	FM_4_0	1	#N/A	0,776	#N/A	#N/A	#N/A
FO_36	0,759		37		FO_36	FM_0_0	FM_1_1	FM_2_2	FM_3_0	FM_4_0	1	#N/A	0,759	#N/A	#N/A	#N/A
FO_37	0,759		38		FO_37	FM_0_1	FM_1_1	FM_2_2	FM_3_0	FM_4_0	1	#N/A	0,759	#N/A	#N/A	#N/A
FO_38	0,772		39		FO_38	FM_0_2	FM_1_1	FM_2_2	FM_3_0	FM_4_0	1	#N/A	0,772	#N/A	#N/A	#N/A

Determination of crucial parameters yielding high AUC values in the fuzzy logic model

Thanks for your attention !