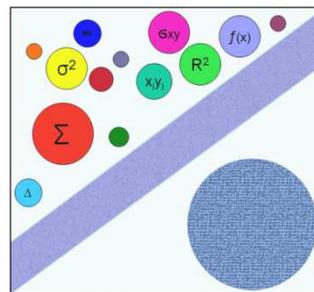


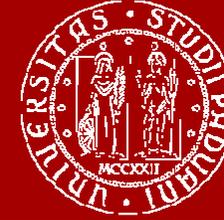
A MULTI-INDICATOR APPROACH FOR COMPARING EMERGENCY DEPARTMENTS

Enrico di Bella*, Luca Gandullia*, Lucia Leporatti*, Marcello Montefiori*,
Patrizia Orcamo**

* University of Genoa

** Regione Liguria, Health Regional Agency (Genoa)





OUTLINE

1. Introduction

How Emergency Departments work in Italy

Aims of the research

Measuring Emergency Department activity

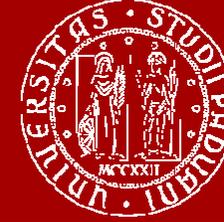
2. Data and Methods

Description of the Dataset

Partial Ordering techniques

3. Results

4. Conclusion and further work



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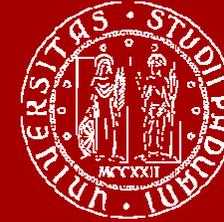
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Introduction

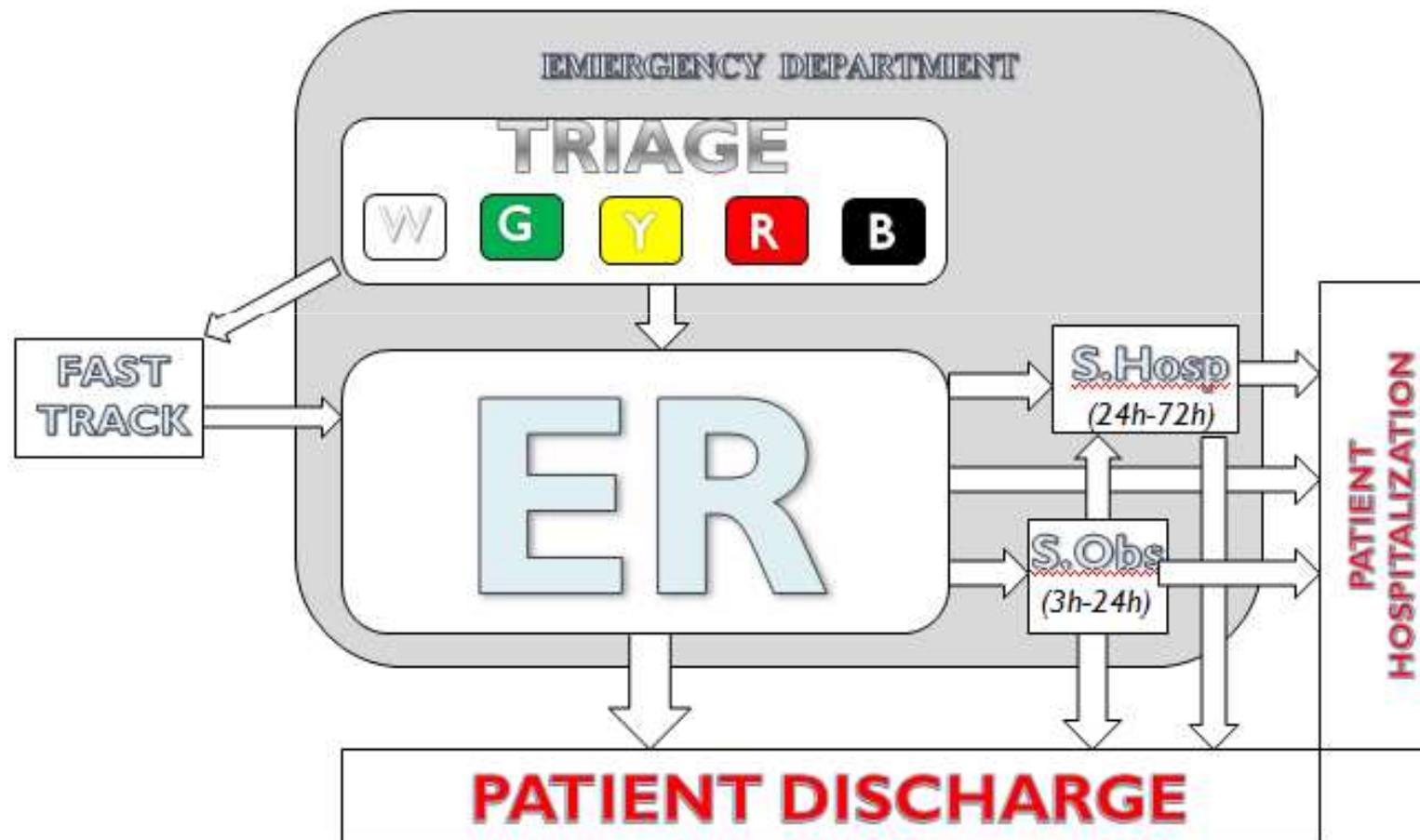
Focus on EDs:

- Very demanding (both in terms of economic resources consumption and programming)
- Responsible for patients hospitalization and diagnostic activity

The main challenges are:

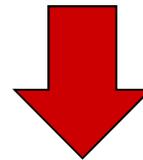
- Cost containment and quality of assistance
- Inappropriateness and overcrowding problems

How Emergency Departments work in Italy: Patients' flow

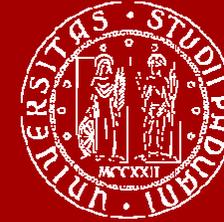


Aims of the research

- Identify suitable measures of emergency department activity;
- Use a new approach (alternative to composite indicators) to:
 - rank (when possible) emergency departments according to the efficiency and quality of the services offered;
 - identify and explain incomparability situations in order to address specific policy actions aiming at improving emergency departments management.



PARTIAL ORDERING APPROACH



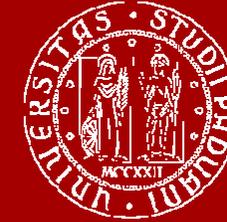
Measuring Emergency Department activity

Measuring efficiency

Provide effective and high quality treatments minimizing the waste in equipment and expenditure

Measuring quality

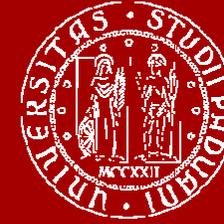
Guarantee a fast recognition of medical conditions and an adequate treatment.



Measuring Emergency Department activity

	INDICATOR	DESCRIPTION
COST EFFICIENCY	COST_Y	Average cost for treatments for a yellow triage patient
	VISIT_Y	Average number of visits for a yellow triage patient
	LAB_Y	Average number of laboratory treatments for a yellow triage patient (e.g. blood test)
	NOLAB_Y	Average number of non laboratory treatments for a yellow triage patient (e.g. X-ray)
QUALITY	WAIT_Y	Average waiting time before receiving the first visit for yellow triage (minutes)
	WAIT20_Y	Percentage of yellow triage patients who wait more than 20 minutes
	LOS_Y	Average length of staying in the ED for a yellow triage patient (minutes) from arrival to outcome (discharge/hospitalization)
	SEVERITY	Ratio between the number of severe accesses (yellow and red triage) and the number of not urgent accesses (green and yellow triage)

References: Sørup et al., 2013; Schull et al., 2011



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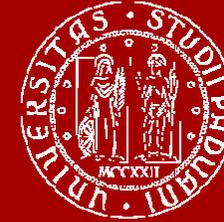
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Description of the dataset

Registry of accesses to 19 EDs located in Liguria during 2013

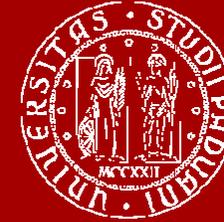




Description of the dataset

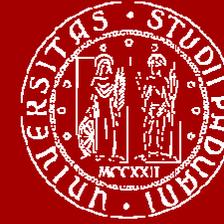
Registry of accesses to the 19 EDs of Liguria (Italy) for year 2013.

- Date and time of arrival, first visit and discharging.
- Triage entrance code.
- Patient's personal information (as gender, date of birth, residence and nationality).
- Means of transport (i.e. the arrival mode): ambulance, air ambulance, etc.
- Laboratory and non-laboratory prescriptions.
- Patient outcome.
- Discharging code.

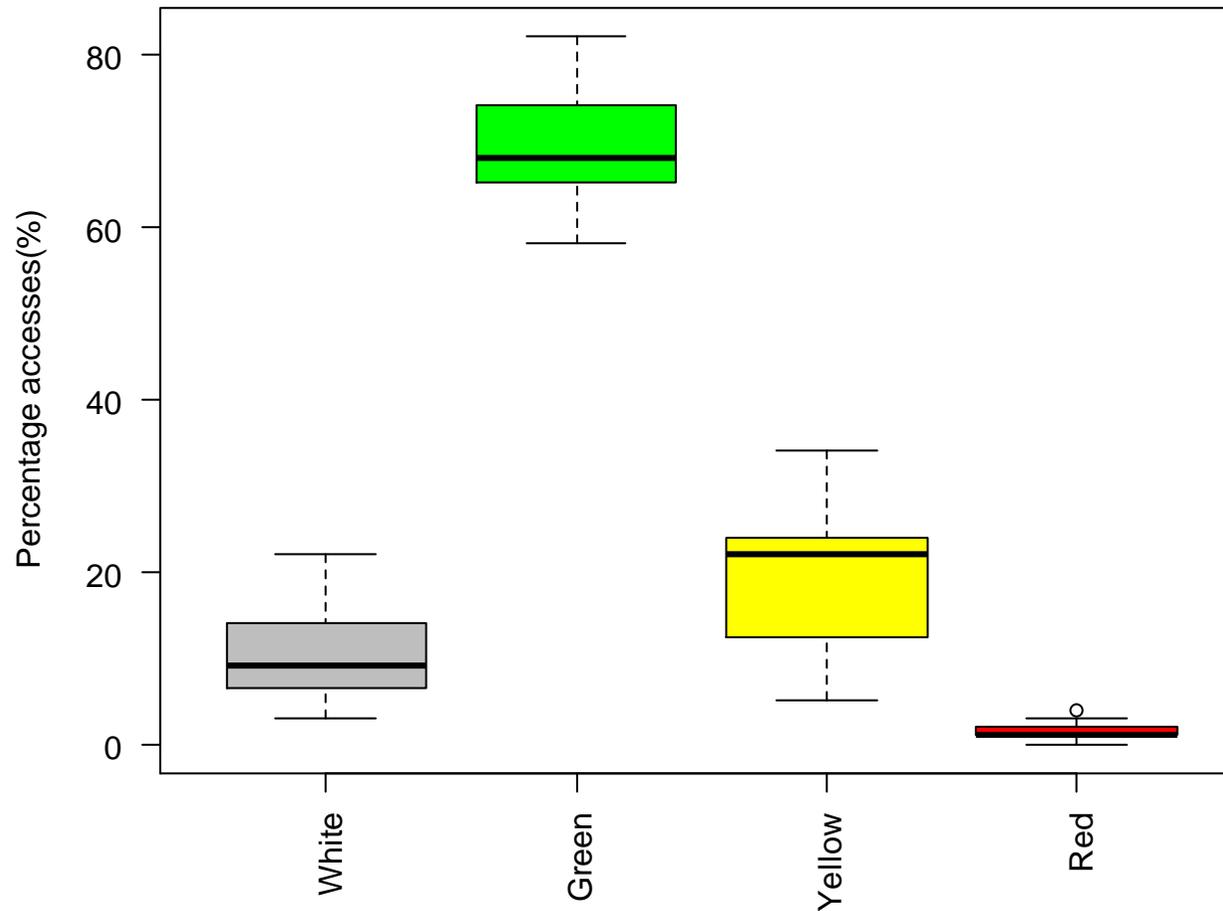


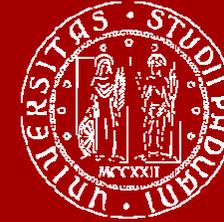
Description of the dataset

- 19 EDs
- 633,982 accesses in 2013
- Difference workload:
 - **7 BIG EDs** = more than 40,000 accesses during 2013.
 - **7 MIDDLE EDs** = from 20,000 to 40,000 accesses during 2013.
 - **5 SMALL EDs** = less than 20,000 accesses during 2013.
- One pediatric ED
- 9 EDs have a seasonal trends in accesses



Accesses by triage code





Methods: partial ordering techniques

→ Pre-processing of data

- Compute 8 indicators of ED activity
- Apply a cluster techniques to divide each indicator in a proper number of levels (Ward method using Duda–Hart stopping rule).

→ Partial Ordering techniques:

- Partially order set theory (**POSET**)
- Partial order scalogram analysis by coordinates (**POSAC**)

References: Shye 1985; Brüggemann and Patil 2011

POSET

In set theory, a totally ordered set is one in which every component A is linked to all other J components by a relation of order such that we always have either $A > J$ or $A < J$ or $A = J$



By transitivity, we can order the entire set and simplify the representation

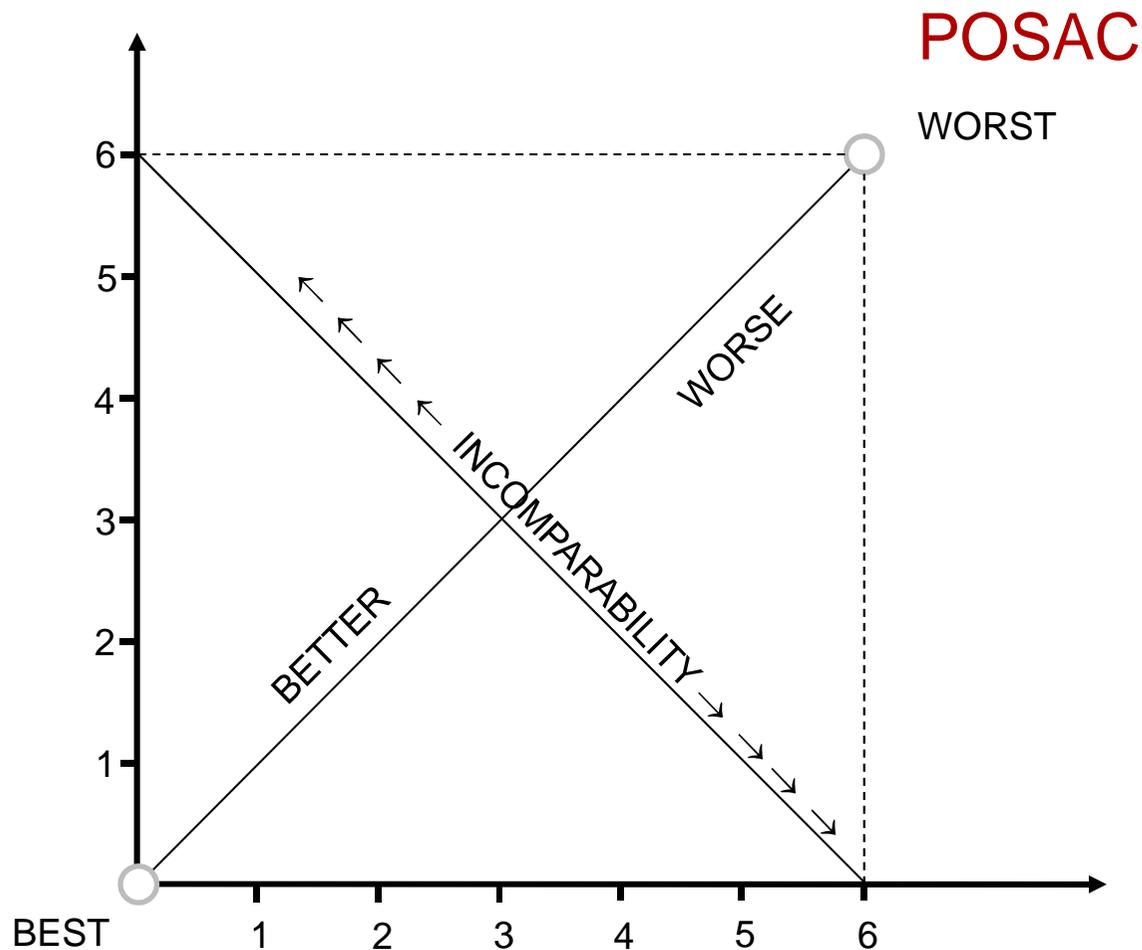
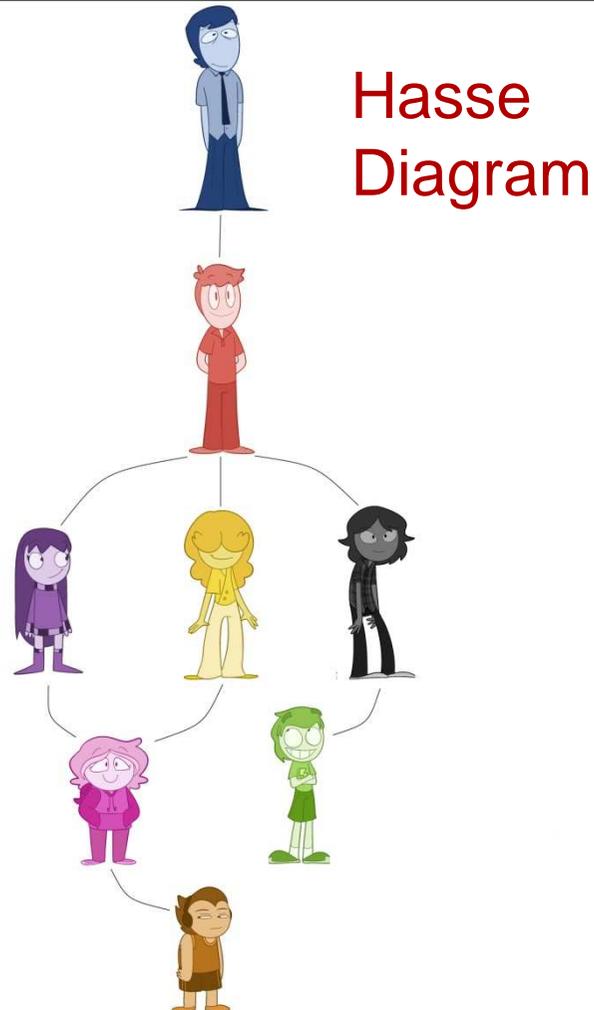
POSET

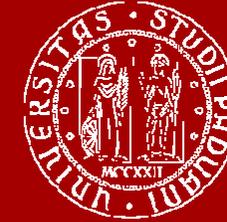
In a partially ordered set, the relation exists only among some couples A, J , and the others cannot be compared. A group of people ordered by height and weight can be a POSET: some elements might be both higher and heavier than some others, but occasionally one might be higher while the other is heavier



Some subgroups of the set are totally ordered, the set is only partially ordered

POSET





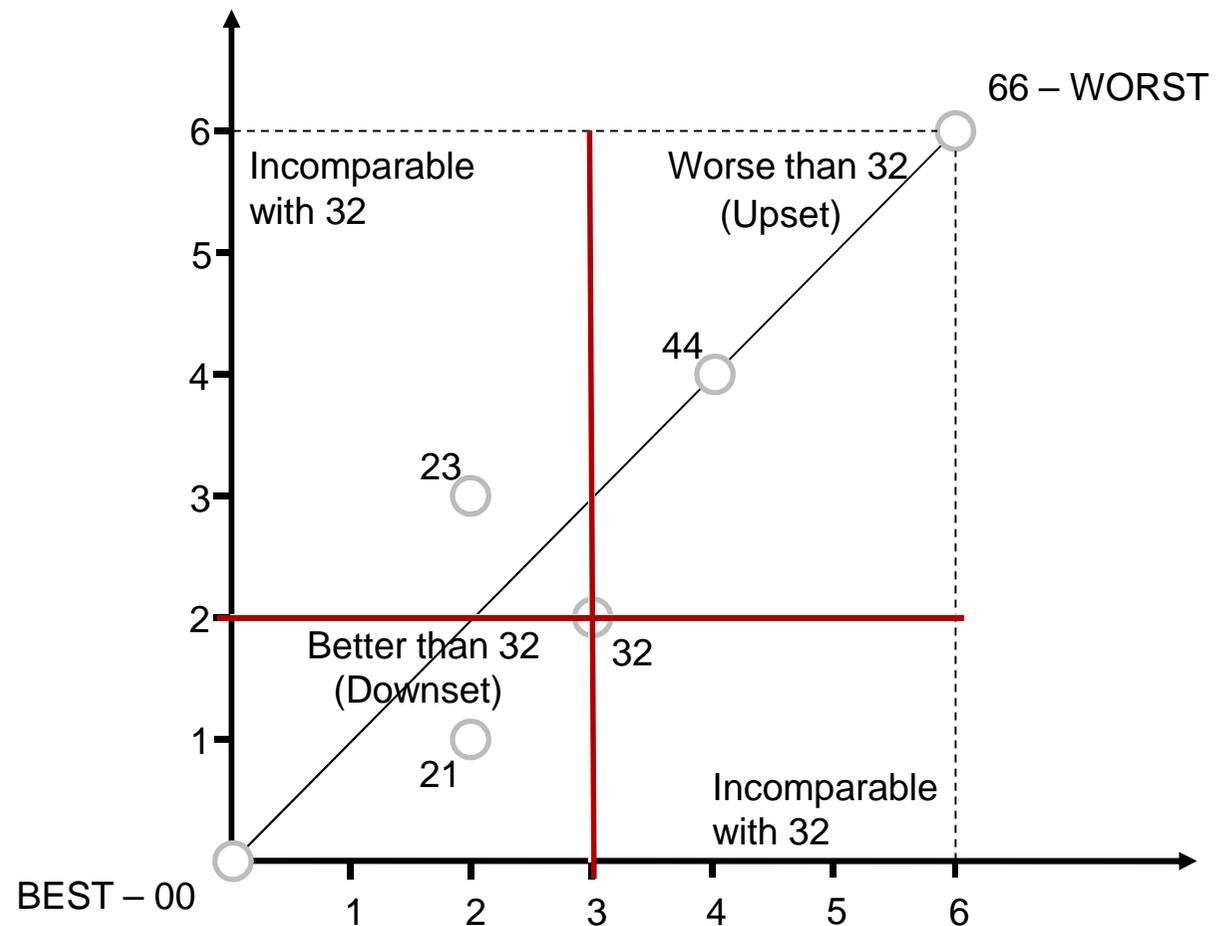
POSAC

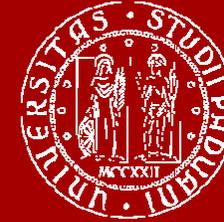
2 indicators :

I_1 : 0 - 6

I_2 : 0 - 6

ID	I_1	I_2
1	6	6
2	0	0
3	4	4
4	2	3
5	3	2
6	2	1
7	5	1
8	1	5

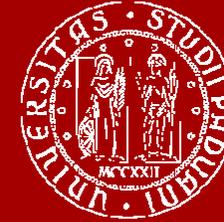




PARTIAL ORDERING TECHNIQUES

→ Compared to composite indicators approach partial ordering techniques :

- Allow an intuitive illustration of partial orders
- Require no weighting assumptions
- Define incomparabilities
- Avoid compensations



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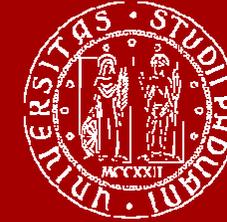
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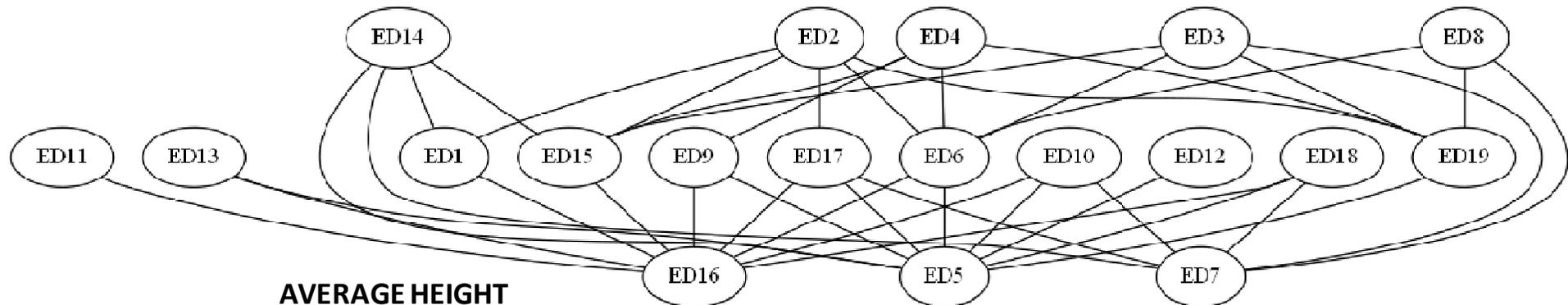
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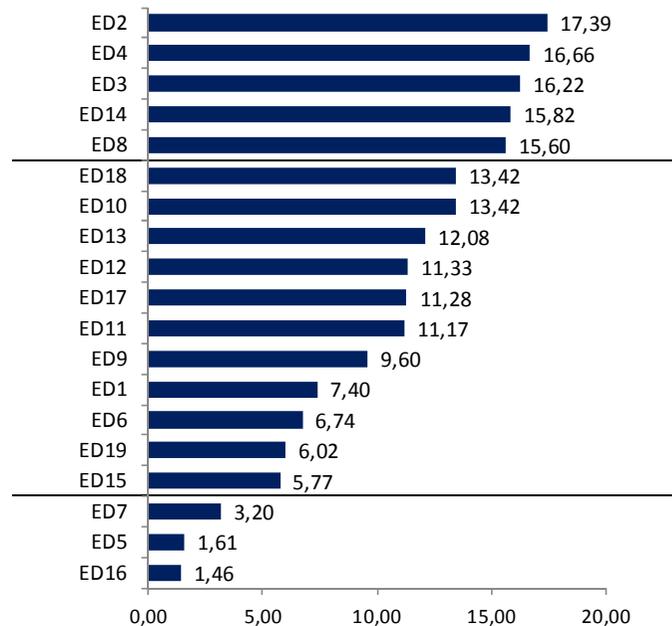
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RESULTS POSET– All the indicators



AVERAGE HEIGHT

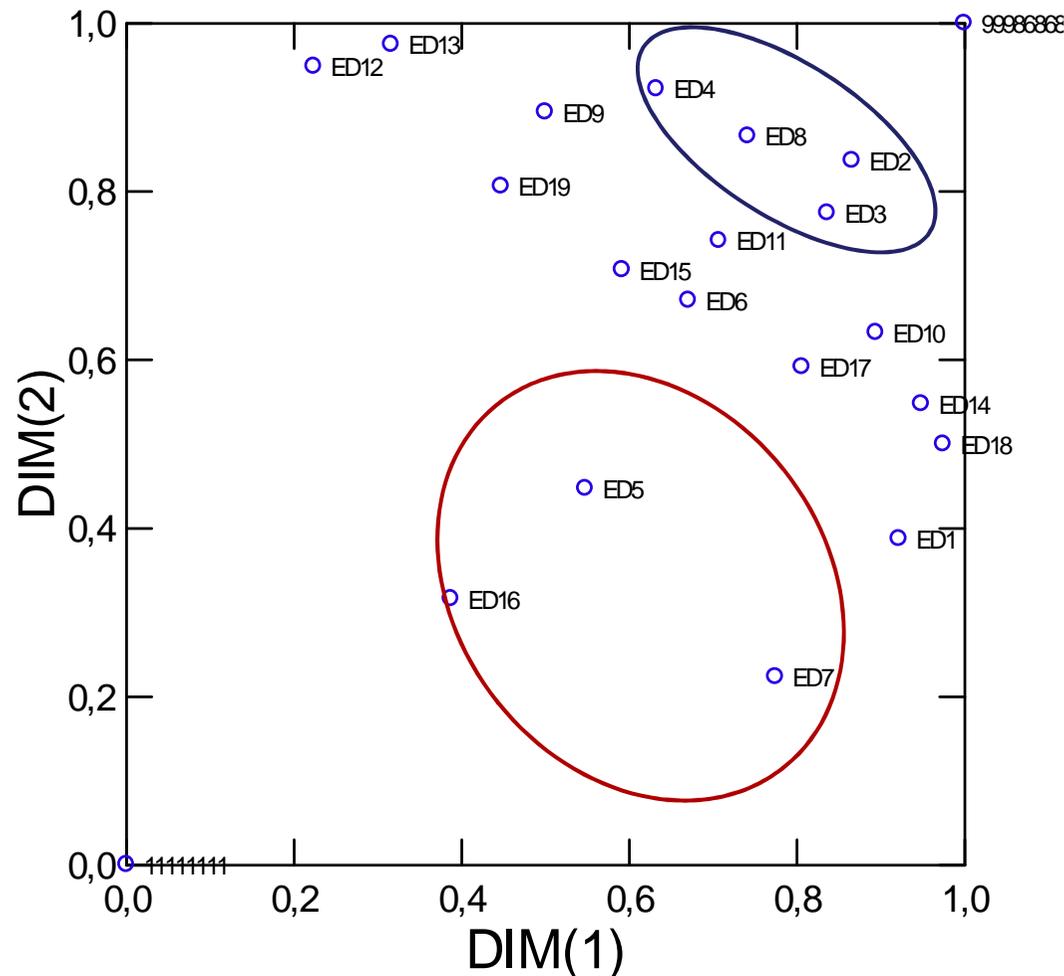


INDICATORS USED:

- COST_Y
- VISIT_Y
- LAB_Y
- NOLAB_Y
- WAIT_Y
- WAIT20_Y
- LOS_Y
- SEVERITY

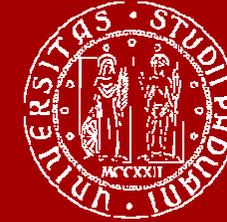
Cronbach's alpha = 0.848

RESULTS POSAC– All the indicators

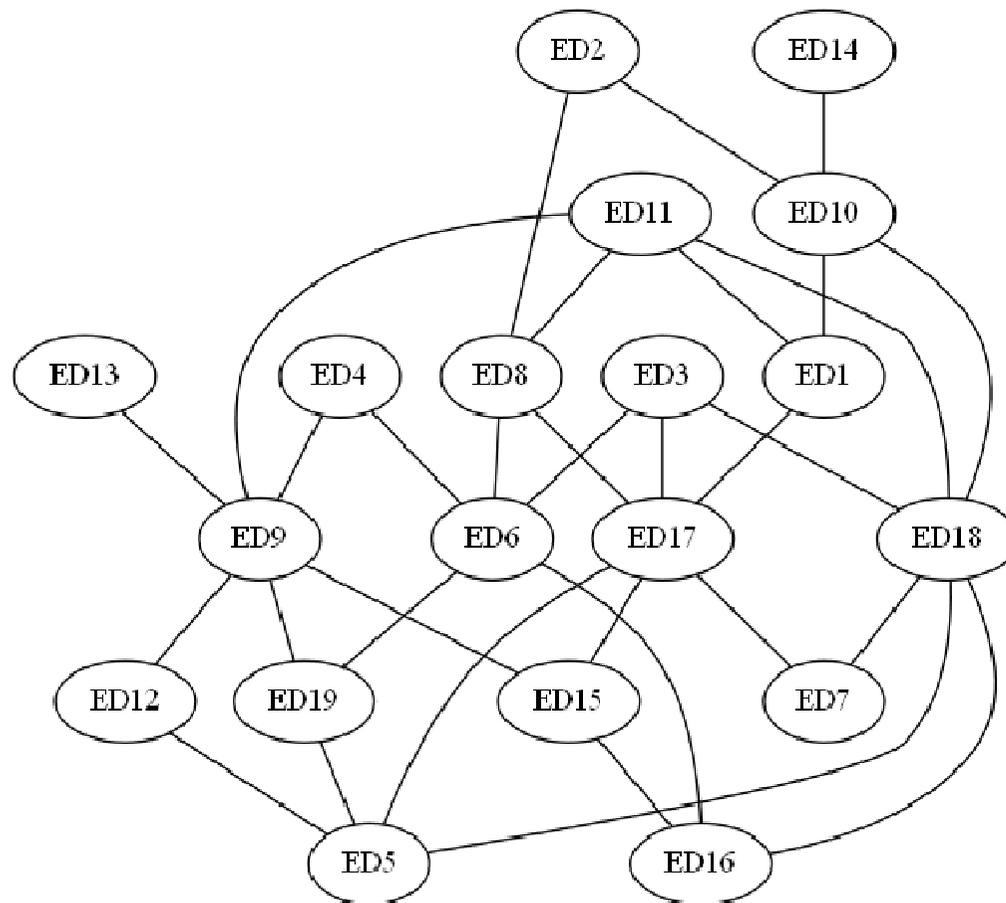


Spearman Correlation	J - Axis	L- Axis
COST_Y	0.678	-0.333
VISIT_Y	0.739	0.492
LAB_Y	0.682	-0.112
NOLAB_Y	0.354	-0.788
WAIT_Y	0.424	-0.369
WAIT20_Y	0.377	-0.391
LOS_Y	0.635	-0.066
SEVERITY	0.574	-0.228

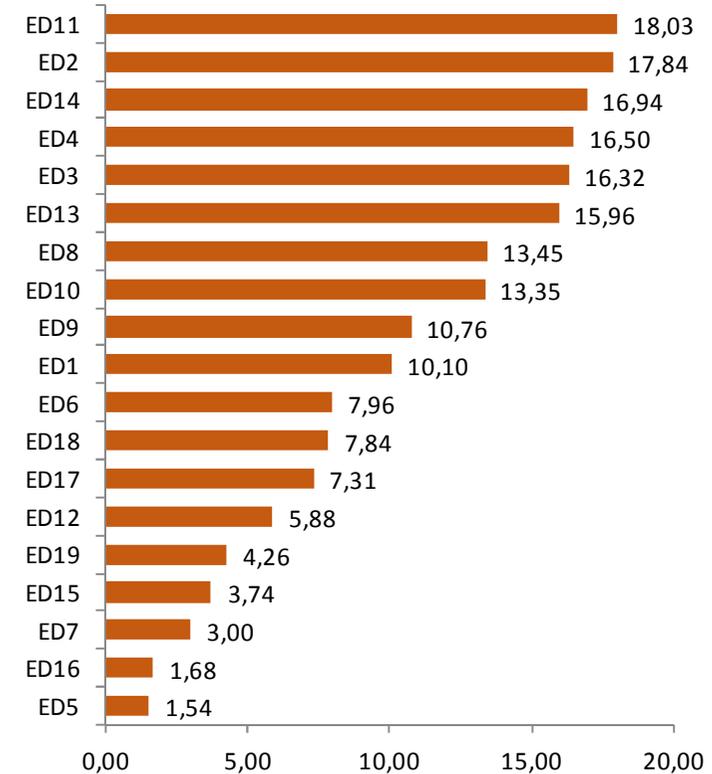
Cronbach's alpha = 0.848



RESULTS POSET– Efficiency indicators

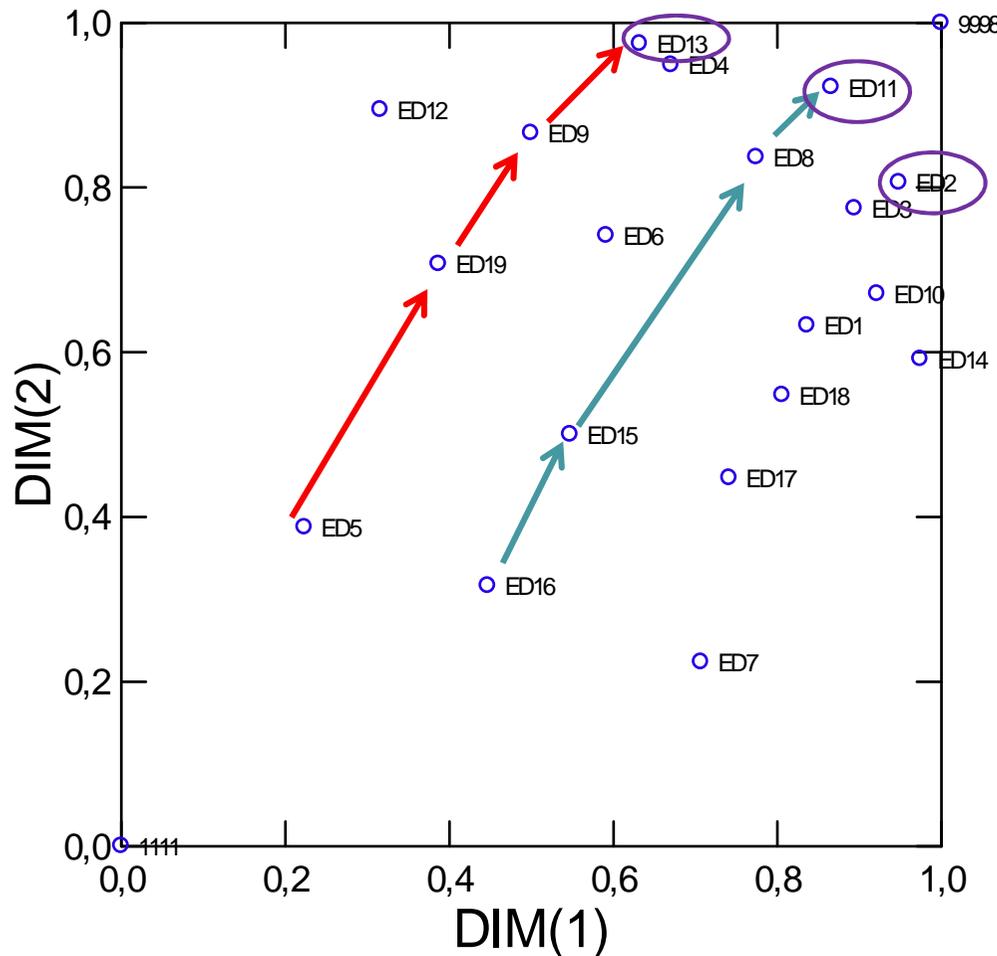


AVERAGE HEIGHT



Cronbach's alpha = 0.813

RESULTS POSAC– Efficiency indicators

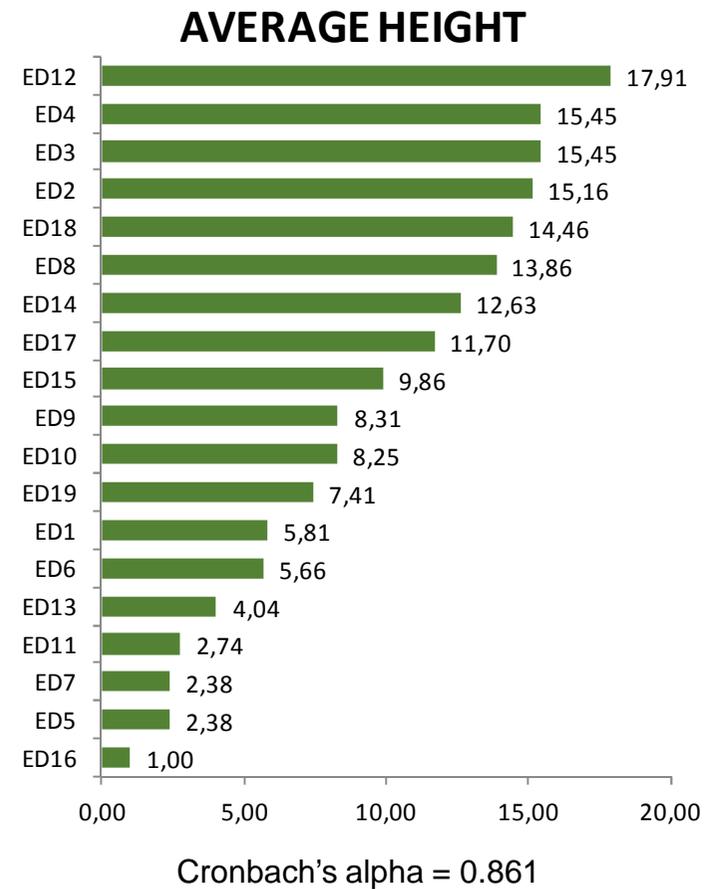
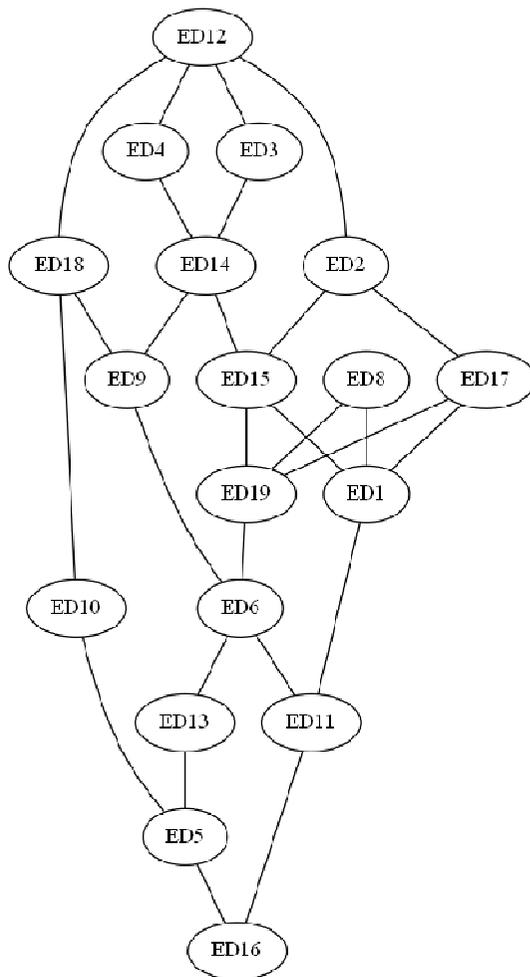


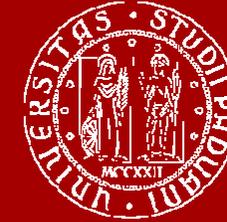
Spearman Correlation	J -Axis	L- Axis
COST_Y	0.872	-0.16
VISIT_Y	0.681	0.584
LAB_Y	0.768	0.073
NOLAB_Y	0.654	-0.684

Cronbach's alpha = 0.813

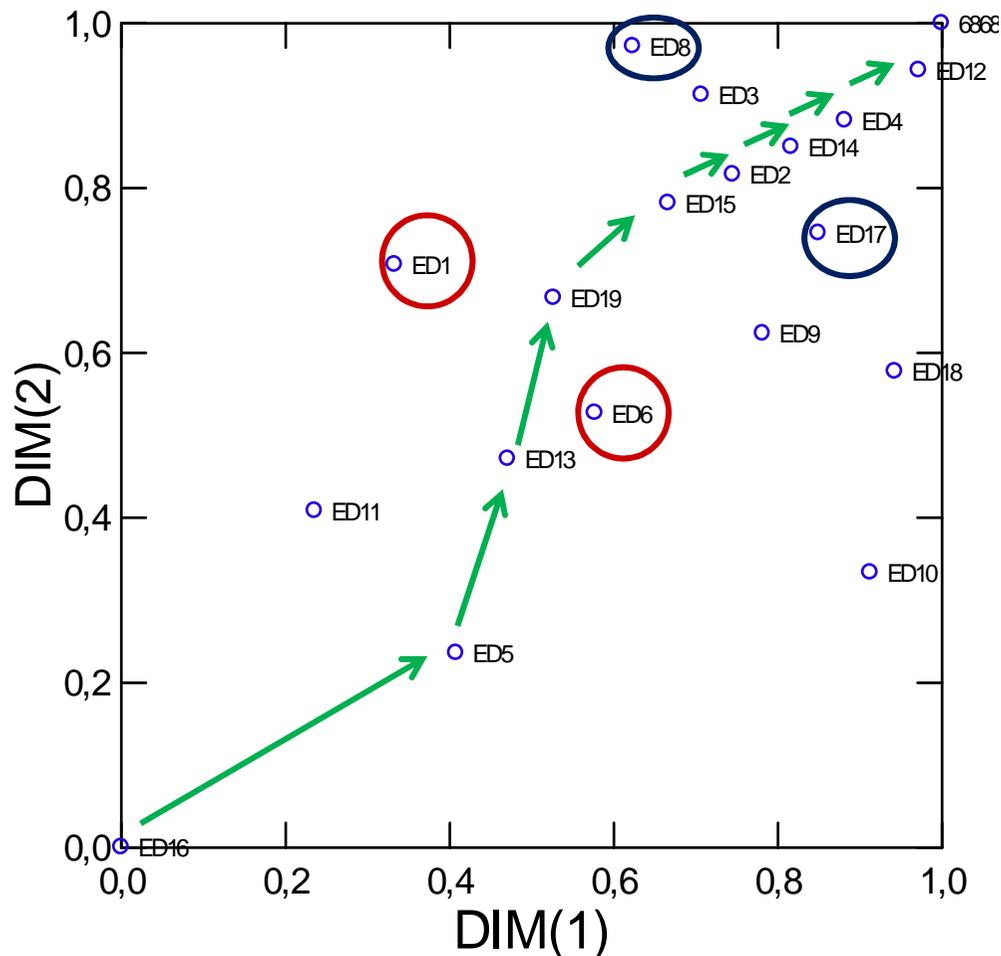
Average Rank	ED2	ED11	ED13
	6.5	6.5	6.5
COST_Y	7	7	8
VISIT_Y	7	7	3
LAB_Y	7	6	7
NOLAB_Y	5	6	8

RESULTS POSET– Quality indicators





RESULTS POSAC– Quality indicators

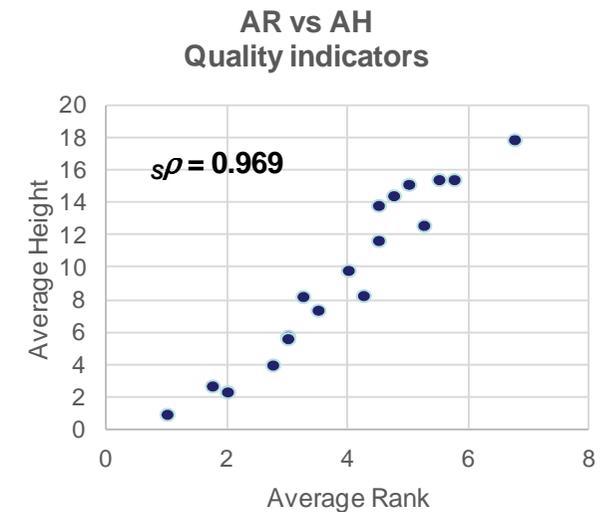
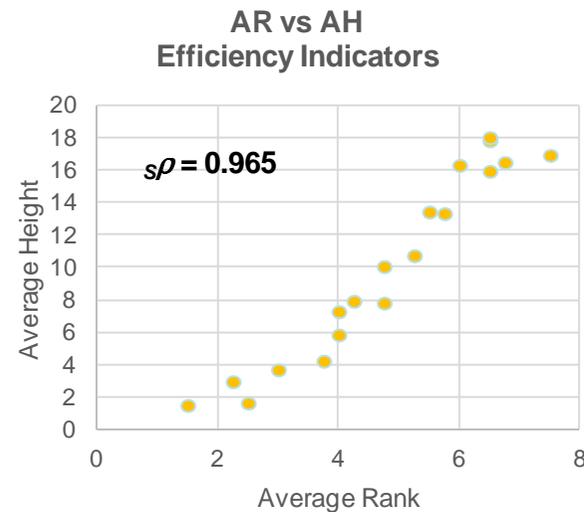
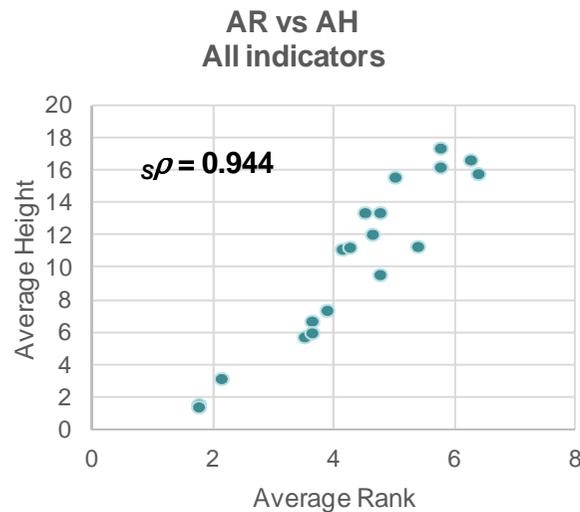


Spearman Correlation	J - Axis	L- Axis
WAIT_Y	0.881	-0.063
WAIT20_Y	0.864	0.04
LOS_Y	0.771	0.211
SEVERITY	0.820	-0.559

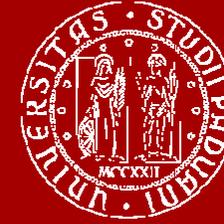
Cronbach's alpha = 0.861

Average Rank	ED1	ED6	ED8	ED17
	3.00	3.00	4.5	4.5
WAIT_Y	2	3	3	3
WAIT20_Y	2	4	4	4
LOS_Y	2	2	3	5
SEVERITY	6	3	8	6

COMPARING RESULTS



- Average rank and average height are strongly correlated.
- However compensation should be avoided



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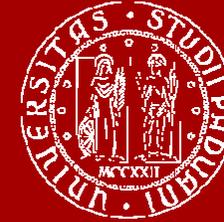
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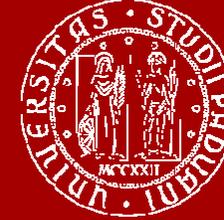
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CONCLUSION AND DISCUSSION

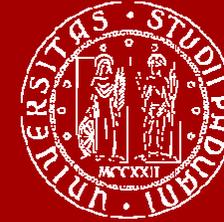
- The ranking of EDs according to their costs and quality is propaedeutic to detect best practices or critical issues that require corrections.
- Incomparability among EDs (in particular shifts from the J-axis in POSAC) is a source of information which may suggest clear policy actions.
- Partial ordering techniques are suitable instruments to provide the decision makers with a number of different lines of actions.
- Creating very big multi-indicator systems may cause too many incomparabilities.



FURTHER WORK

- Evaluation of the robustness of the procedure with additional indicators.
- Introduce indicators importance/priority in the definition of ED activity, maybe different according to the type (cluster) of AEDs.
- Try to develop effective communication for Regional Healthcare System decision makers

THANK YOU FOR YOUR ATTENTION!



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