

Comparing well-being across ages and regions in Italy: a new «non-aggregative» procedure for ranking on multi-indicator systems

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Well-being in Italy

Well-being is **multidimensional**, for instance considering only incomes is not enough. It is necessary to consider also other indicators, some of which can not be easily quantified.

Italian territory is divided into different **regions** with different characteristics. Moreover age, gender and territory interact in determining the individual well-being.

Politics needs **synthesis**. Rankings may be useful to set priorities and identify differences.

Synthesis is not simplification: **complexity** may be preserved and described.

Fuzzy First Order Dominance (**Fuzzy-FOD**) on partial orders provides such kind of synthesis, starting from a multidimensional definition of well-being, it compares different segments of the Italian population whenever it is possible.

The Fuzzy-FOD methodology

Initial data

- A set of **ordinal variables** composing a Multi-Indicator System (MIS)
- A stratification variable that identifies different **sub-populations**

Goal

- **Ranking** the sub-populations of the stratification variable on the basis of the MIS

Main topics

- Profiles **structure** is a partially ordered set (poset)
- We propose a **non-aggregative** method
- The **fuzzy approach** allows to investigate incompatibilities

The application

Source: multipurpose survey on daily life – Italian National Statistical Bureau

Year: 2015, Number of individuals: 38738 (after data cleaning)

MIS, four **social indicators** about individual satisfaction with

- Economic situation
- Health
- Family relations
- Leisure time

with four levels:

(1) Not at all satisfied < (2) Not satisfied < (3) Quite satisfied < (4) Very satisfied

Stratification variables

- Region
- Age

Some profiles are comparable some others are not

Economic situation	Health	Family relations	Leisure time
4	3	3	1
3	1	3	1
3	3	2	1
1	1	4	3
...

$$(3, 1, 3, 1) \leq (4, 3, 3, 1)$$

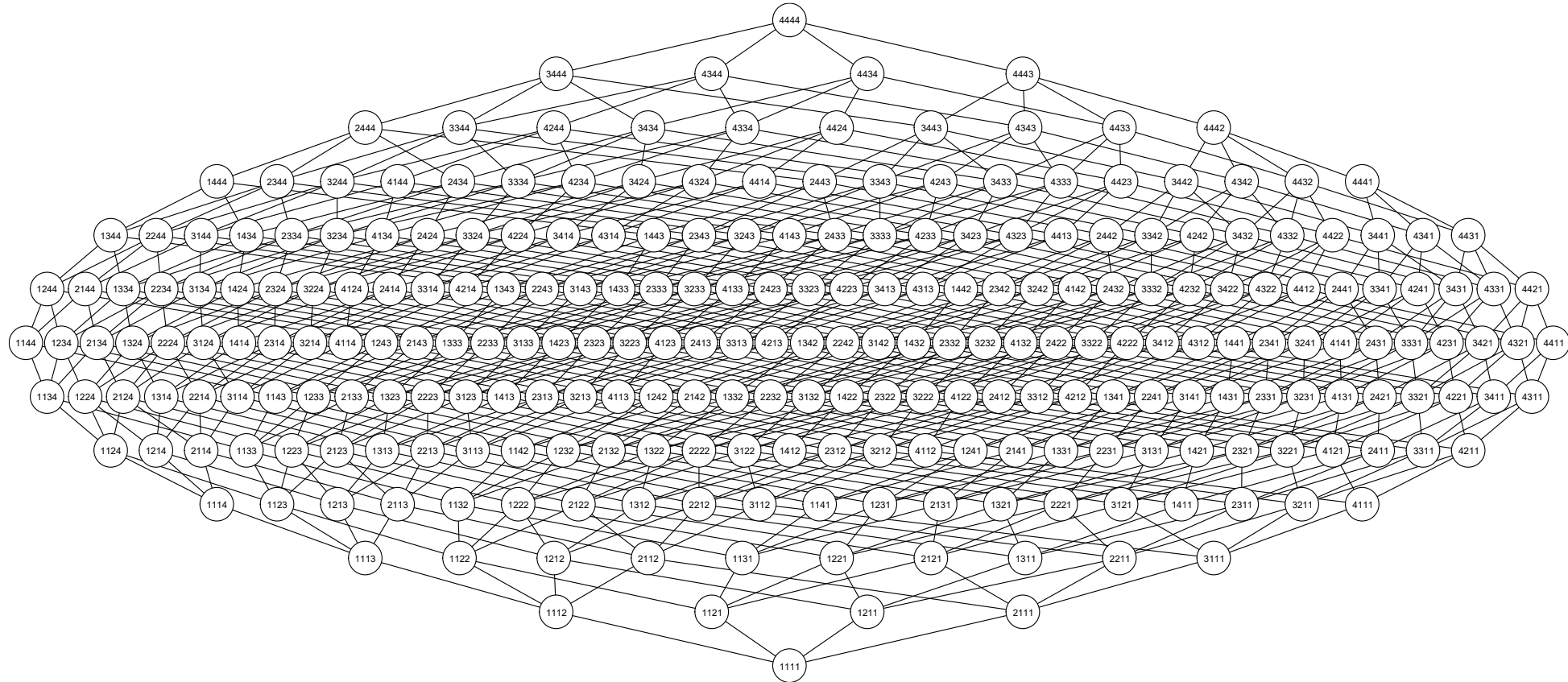
$$(3, 3, 2, 1) \leq (4, 3, 3, 1)$$

$$(1, 1, 4, 3) ? (3, 3, 2, 1)$$

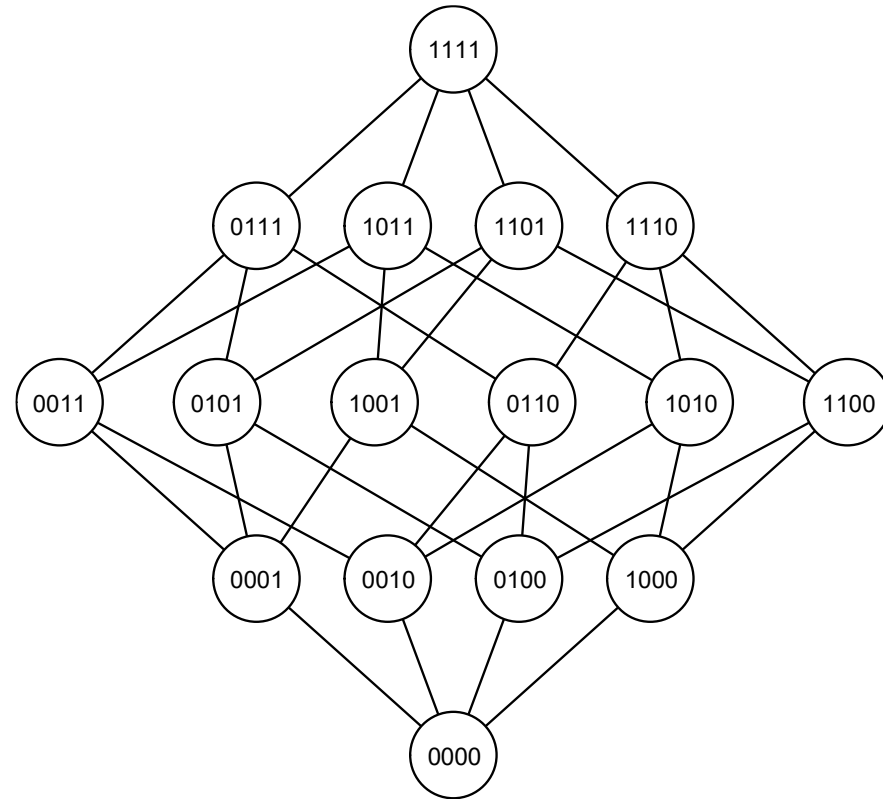
$$(3, 3, 2, 1) ? (3, 1, 3, 1)$$

$$(1, 1, 4, 3) ? (3, 1, 3, 1)$$

The set of profiles is partially ordered



Only two degrees
0 dissatisfied < 1 satisfied



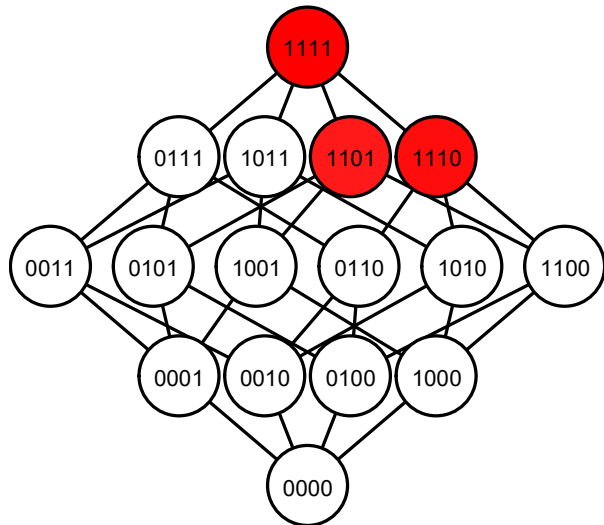
Poset

$\Pi = (X, \leq)$

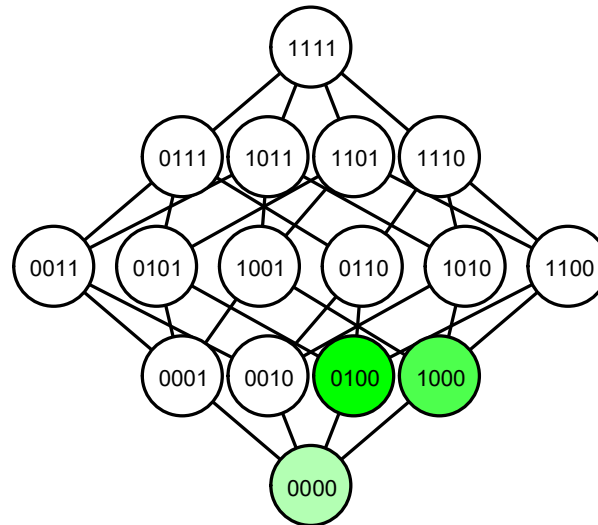
- X a set
- \leq a binary relation
 - Reflexive ($p \leq p \forall p \in X$)
 - Antisymmetric ($p \leq q$ and $q \leq p \Rightarrow p = q; p, q \in X$)
 - Transitive ($p \leq q$ and $q \leq r \Rightarrow p \leq r; p, q, r, \in X$)

Distributions comparisons over posets

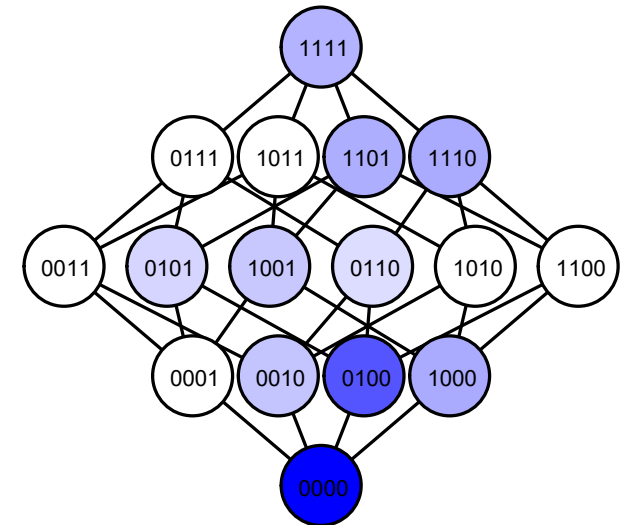
Region 1



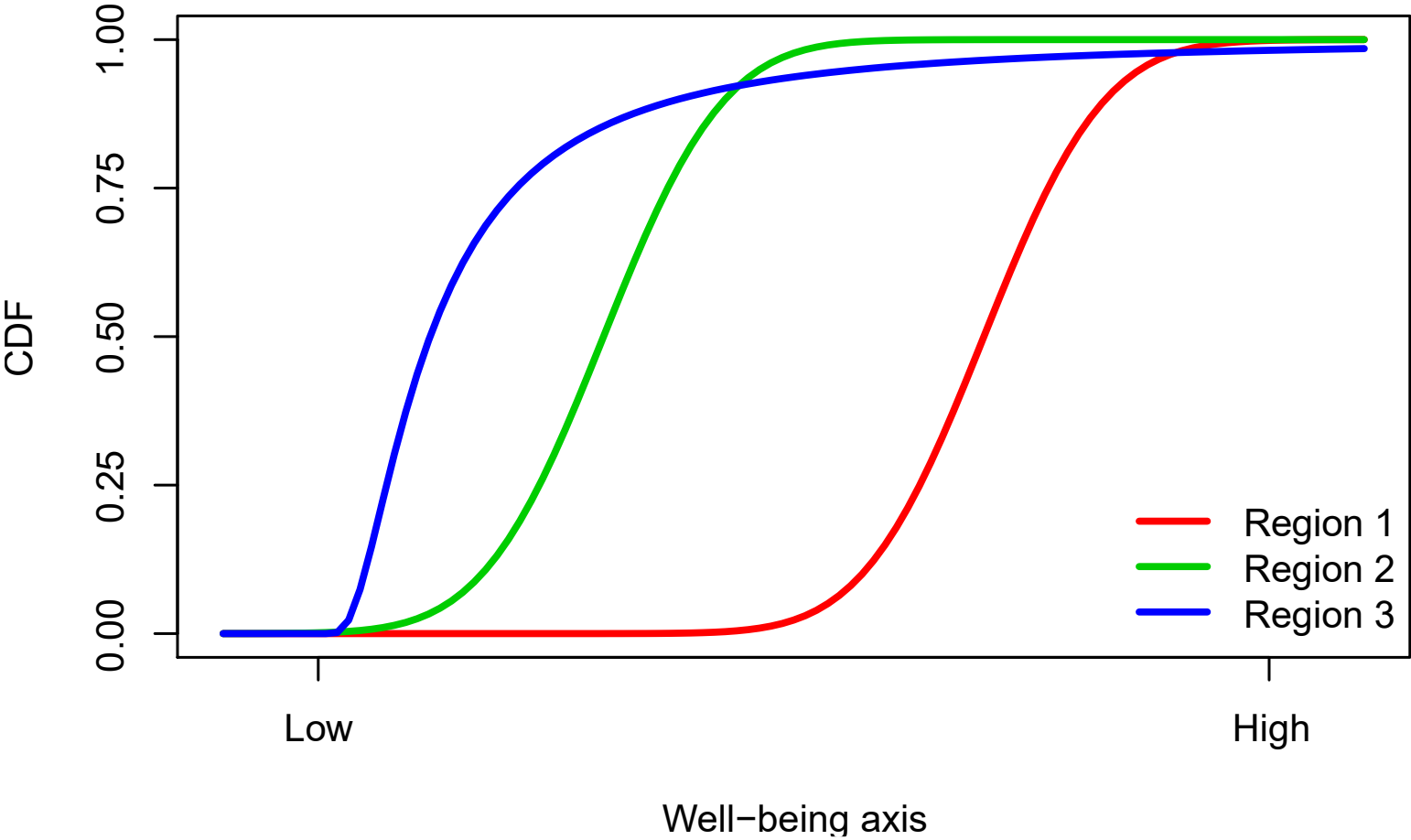
Region 2



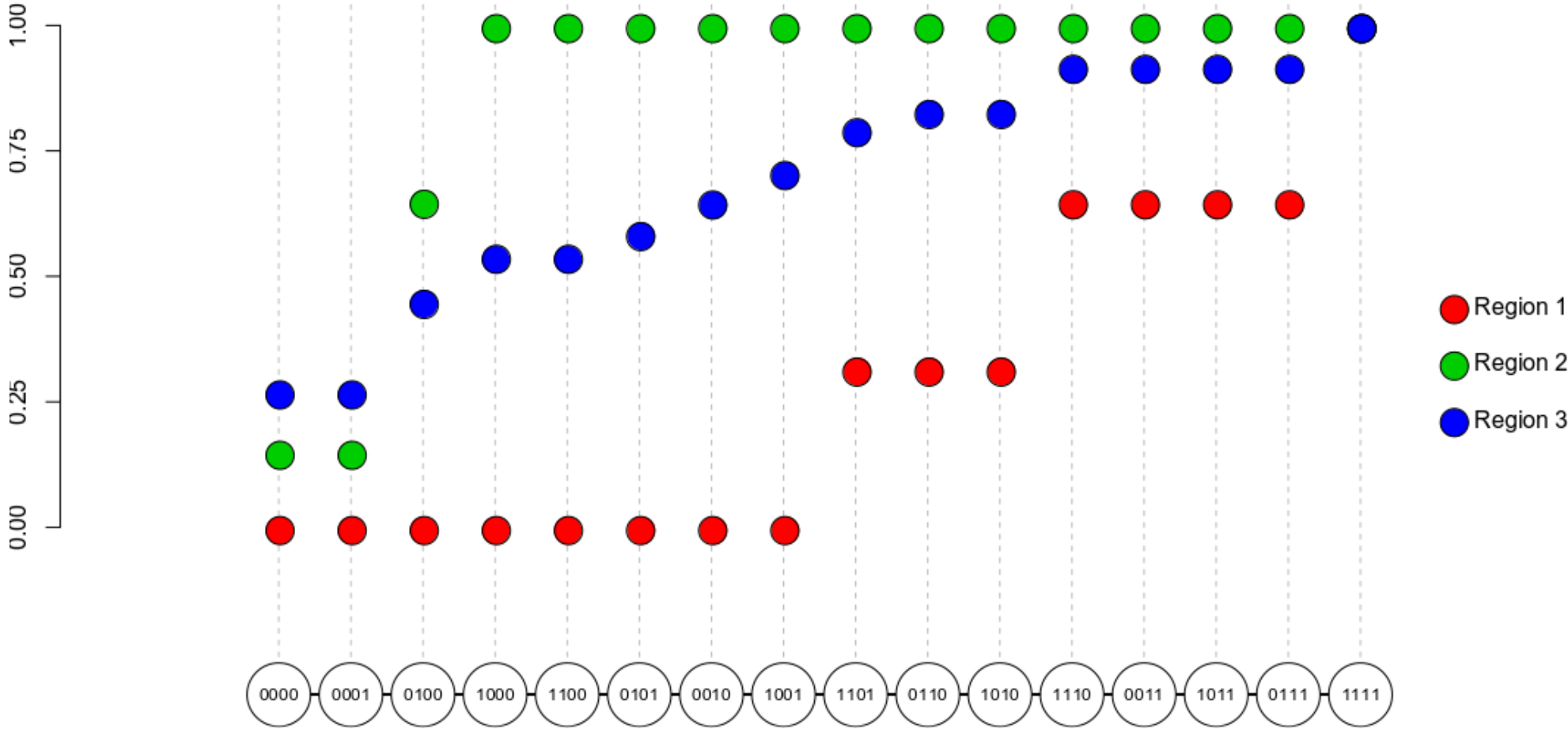
Region 3



First order dominance (FOD) for unidimensional continuous distributions



Cumulative distribution on a Linear Extension



The fuzzy approach

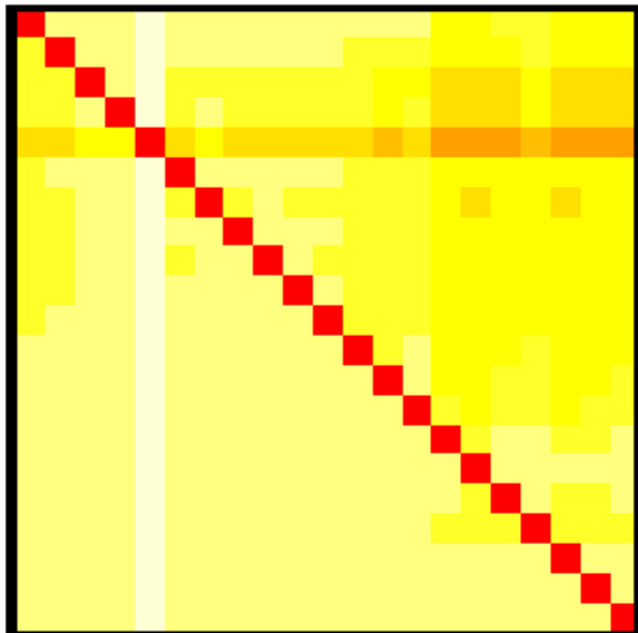
FOD is based on a **binary** relation

In Fuzzy-FOD for each couple of regions R_i and R_j is determined the **probability** that the well-being of an individual of region R_j is higher than that of an individual of region R_i

Trough the choice of a **threshold** α a poset of regions is obtained (called α -cut)

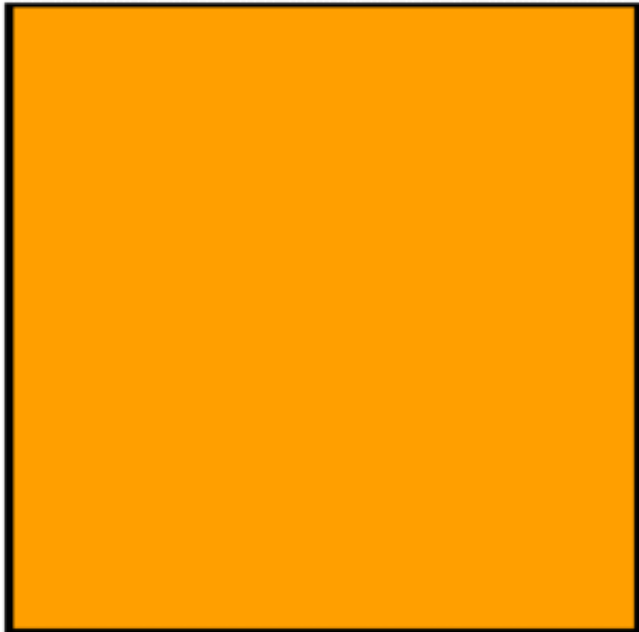
Regions and α -cuts

Fuzzy results



Regions and α -cuts

alpha = 0.4423

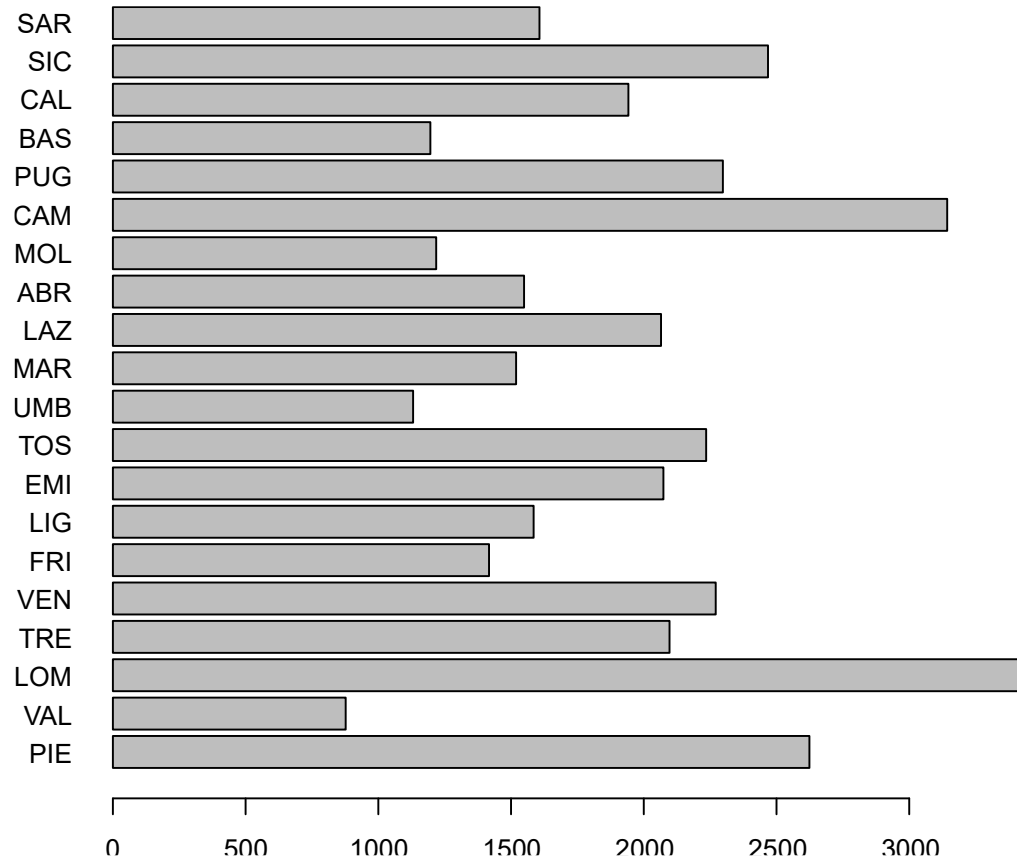


G1

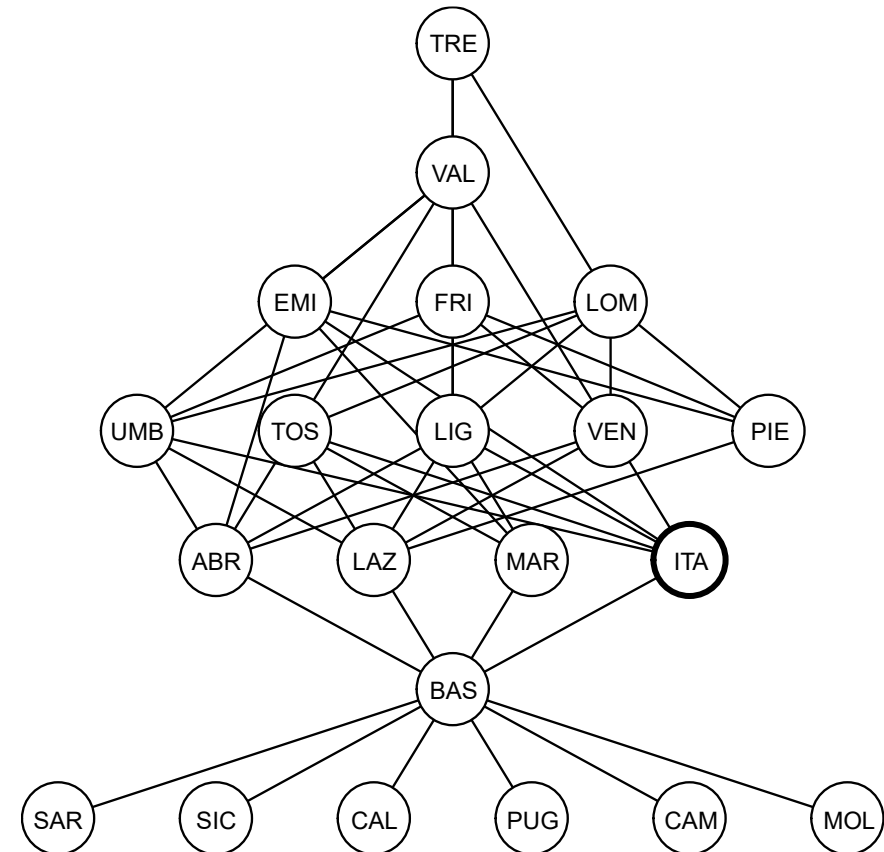


Poset by region

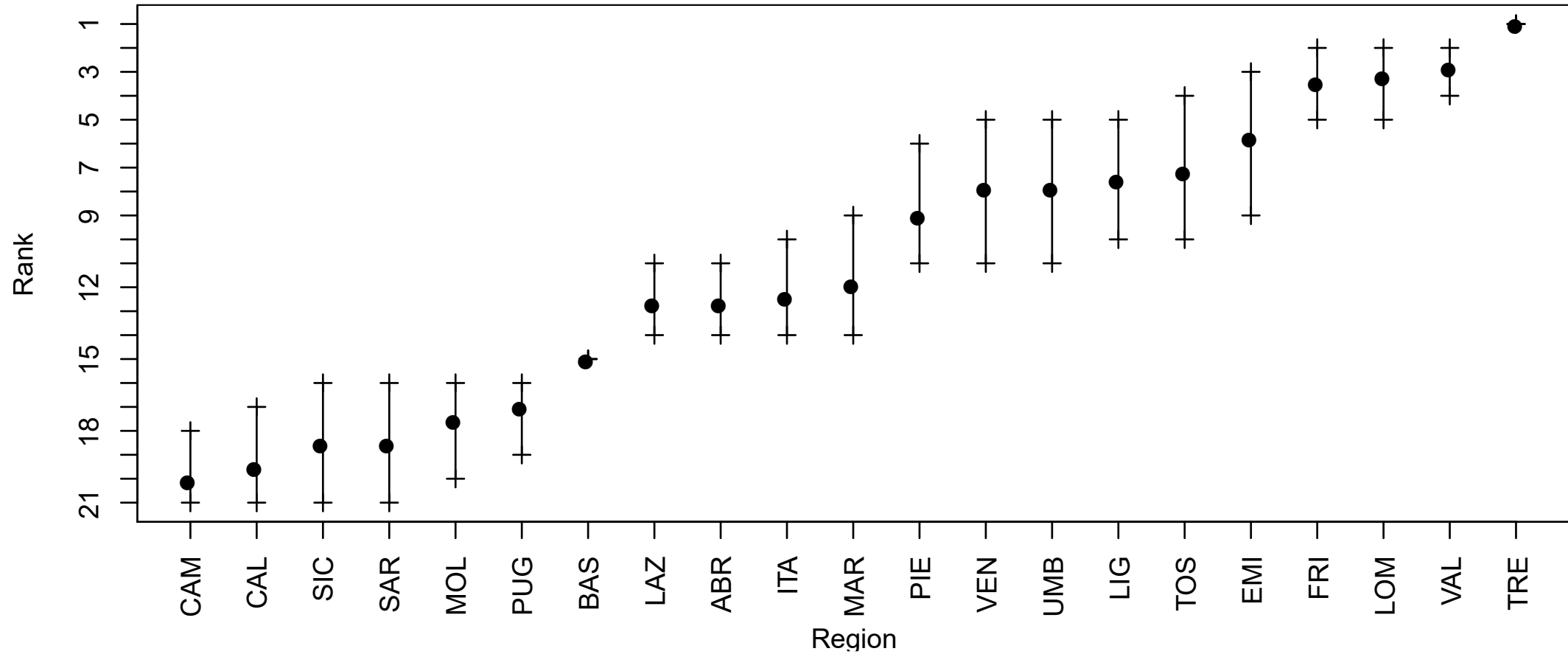
DISTRIBUTION BY REGION



$\alpha = 0.5441$

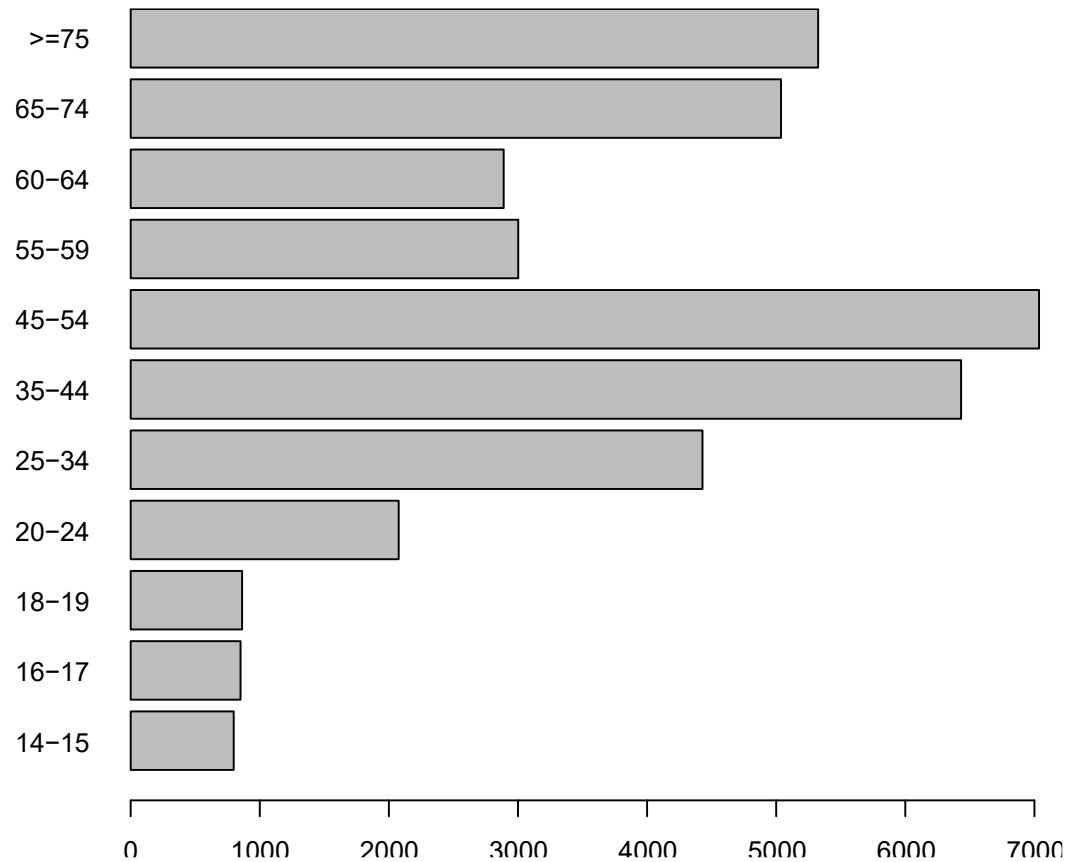


Average ranks of regions

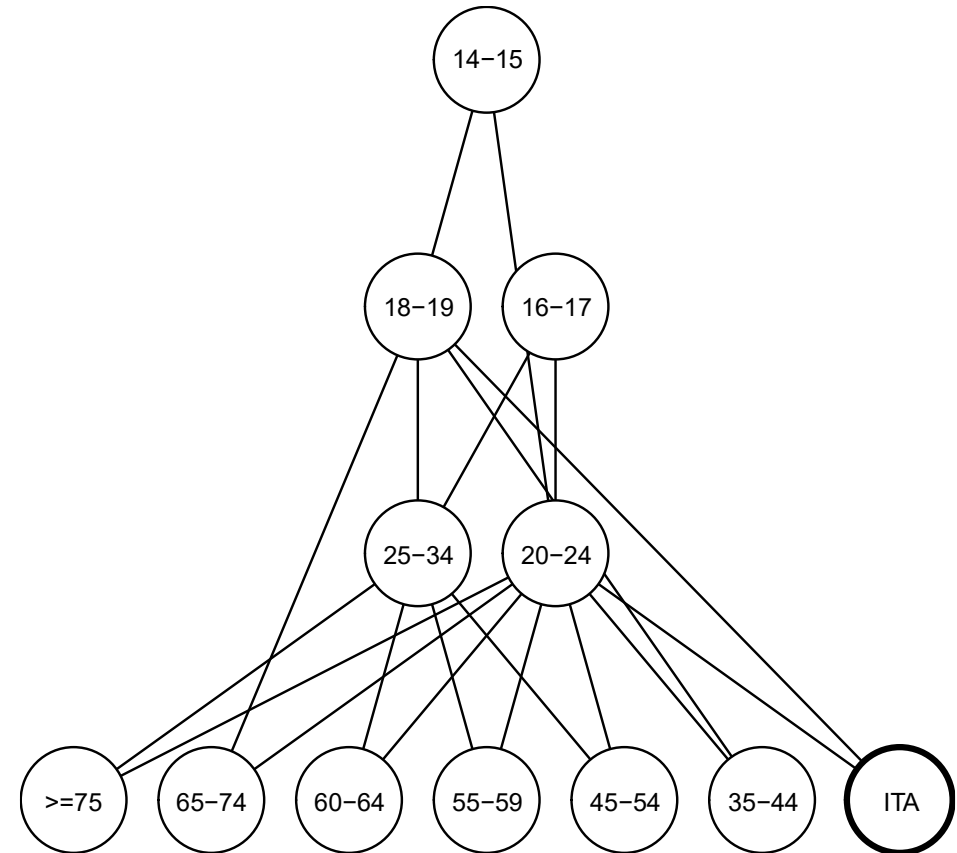


Poset by age

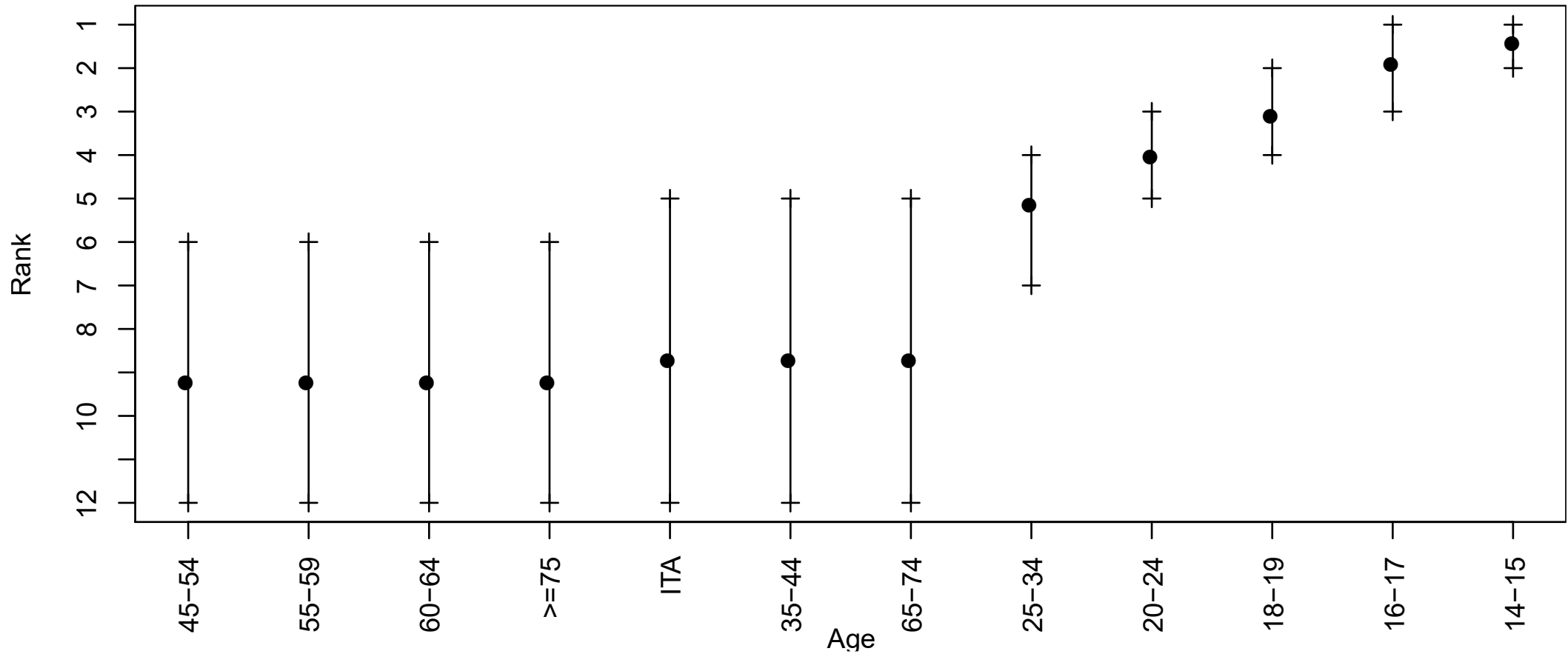
DISTRIBUTION BY AGE



$\alpha = 0.5777$

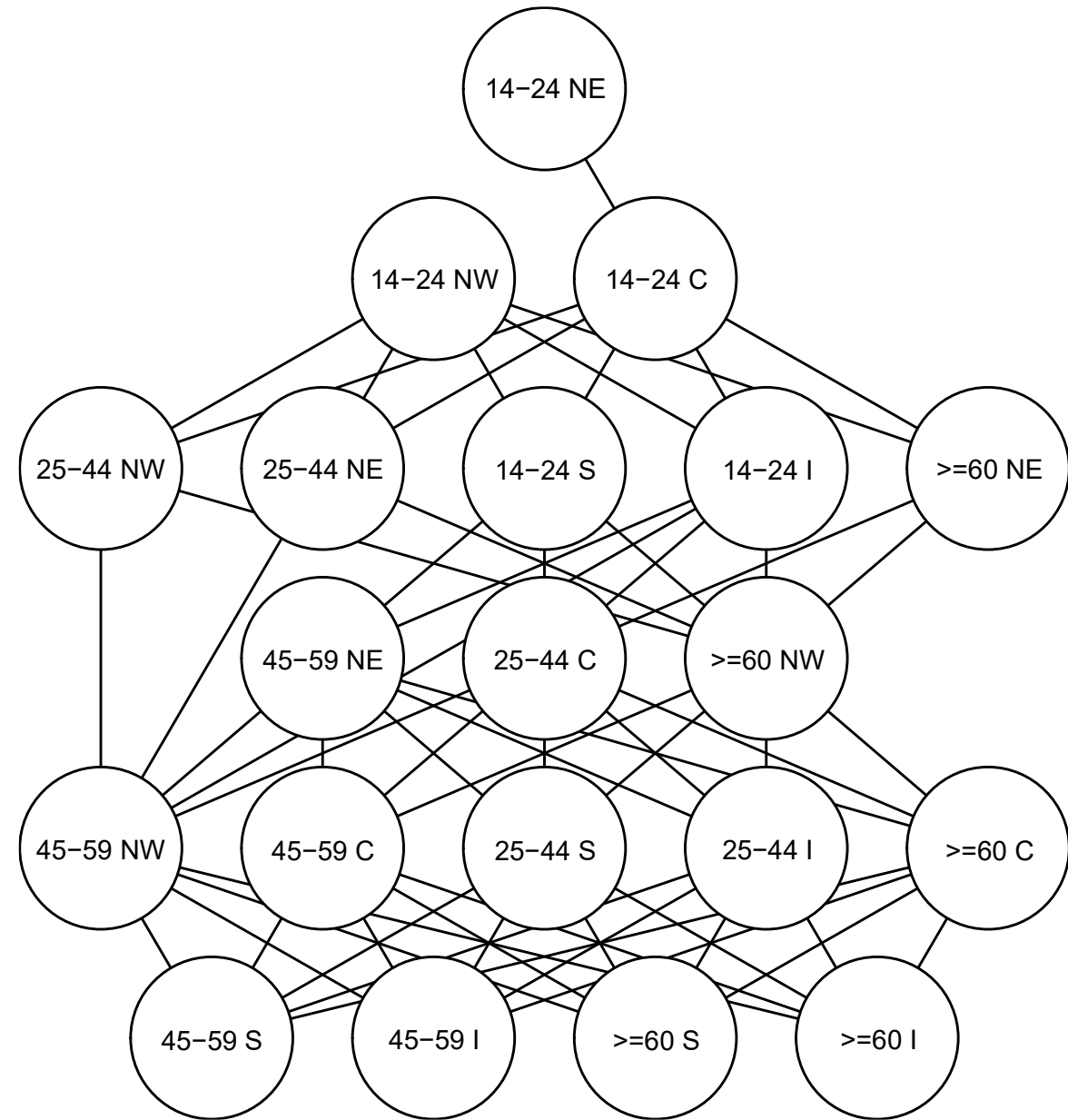


Average ranks of age groups



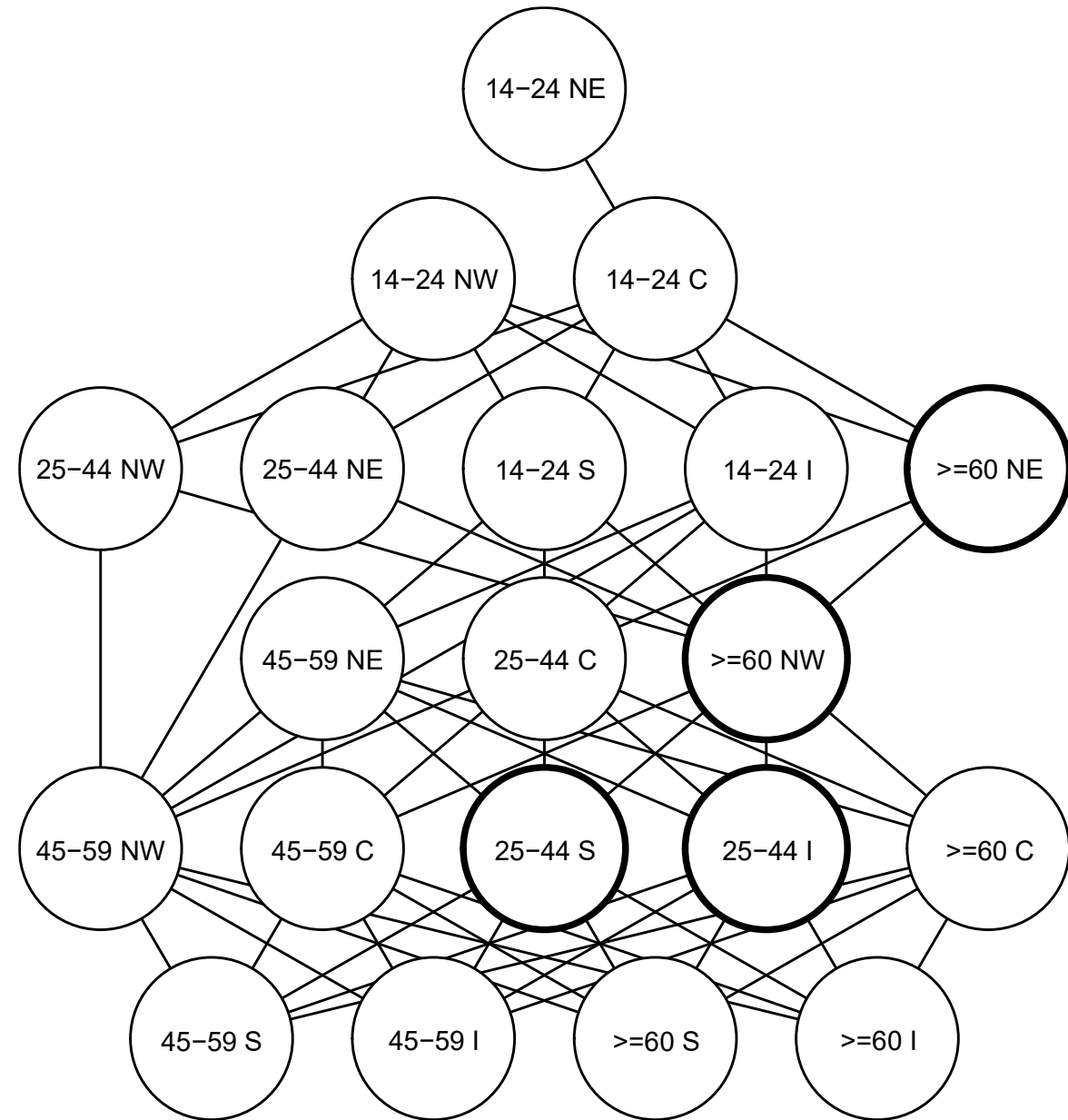
Poset by geographical breakdown and age

$\alpha=0.5623$

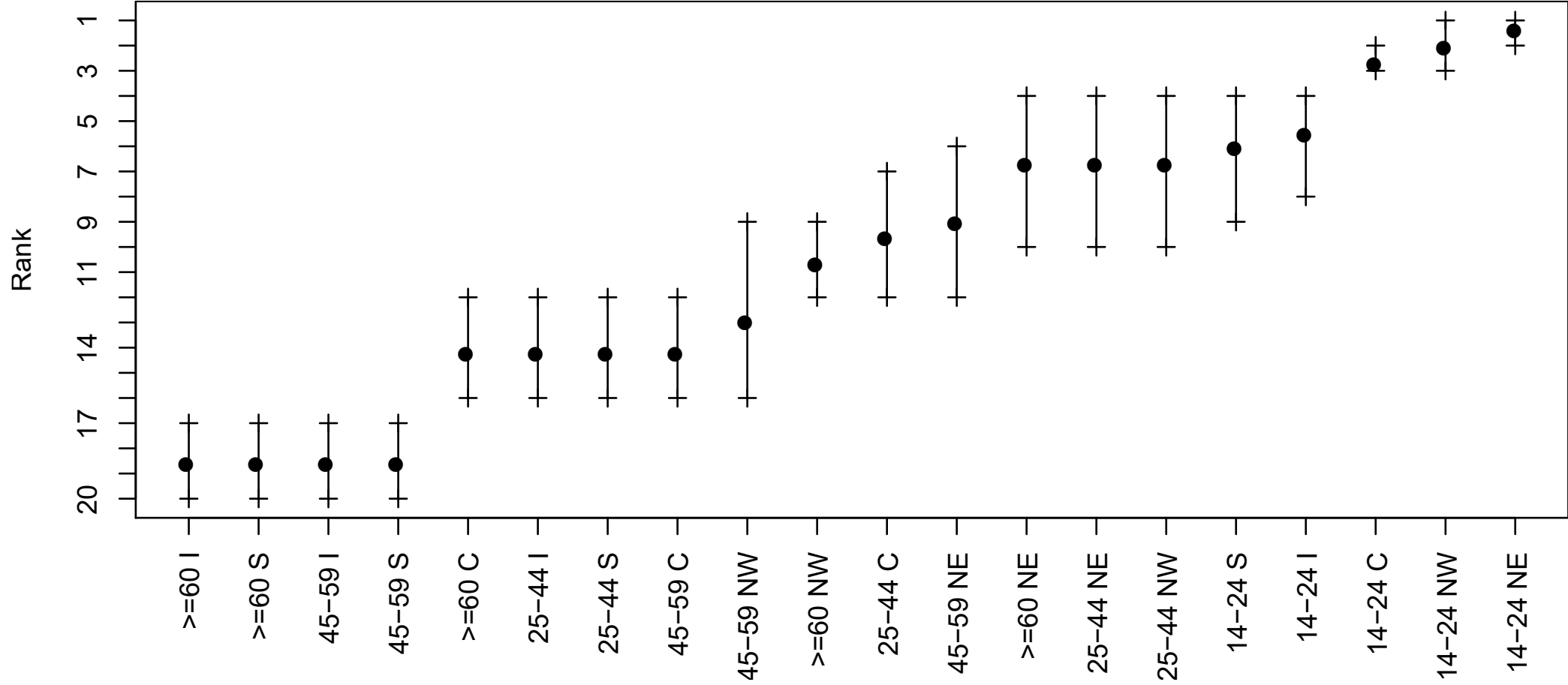


Poset by geographical breakdown and age

$\alpha=0.5623$



Average ranks of combined classes



Main bibliography

Arcagni A. (2017), PARSEC: An R Package for Partial Orders in Socio-Economics, in Fattore M., Bruggemann R. (eds) Partial Order Concepts in Applied Sciences. Springer, Cham

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Istat. (2015) Multiscopo ISTAT - Aspetti della vita quotidiana. UniData – Bicocca Data Archive, Milano. Survey code SN167. Data file 1.0