A statistical analysis on factors that contributed/slowed down the spread of COVID-19

Project for the exam: Machine learning, statistical learning, deep learning and artificial intelligence - Unsupervised Learning

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Overview

FINAL GOAL: Survey the statistical correlations between the COVID-19 cases/deaths and a selected set of attributes for different clusters via the principal component analysis

CLUSTERS: Provinces (IT), Regions (IT), Countries

Cluster features

Provices (IT)

- Unemployment '19
- Private Transport '12
- Air Quality '19
- Public Transport '12
- Density '19
- Mean income '19

Regions (IT)

- Mortality
- Pop. for GP
- Mean Income '19
- Number of Visits for Pop. '17
- Public Transport
- Density '19
- Mean income '19
- Tests
- LEA '17
- Number of visit '17
- Public structures '17

Countries

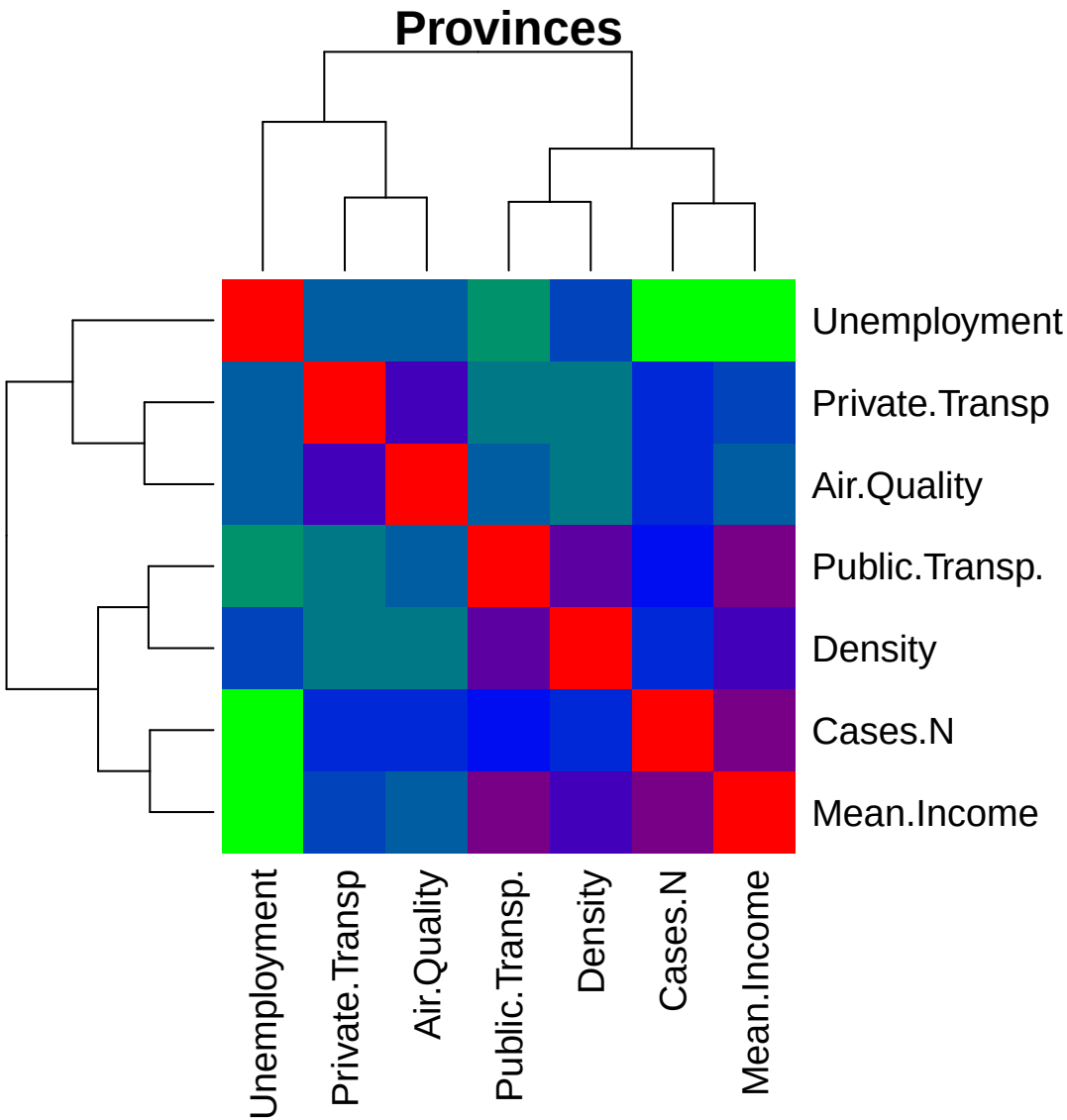
- $PM_{2.5}$ '16
- Traffic Mortality '16
- Pollution Mortality '16
- GDP pro-capita '19
- Health expenditure '17
- UHC '17

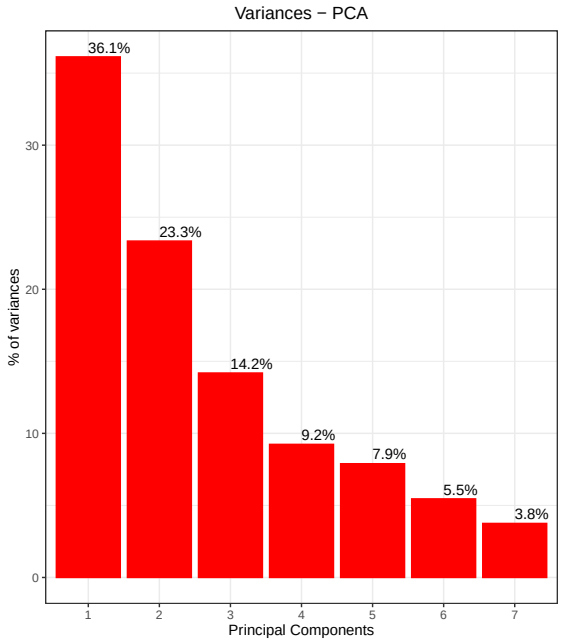
Datasets features

TEMPORAL INTERVAL: Provinces up to 24/08/2020; Regions up to 24/08/2020; Countries up to 27/08/2020

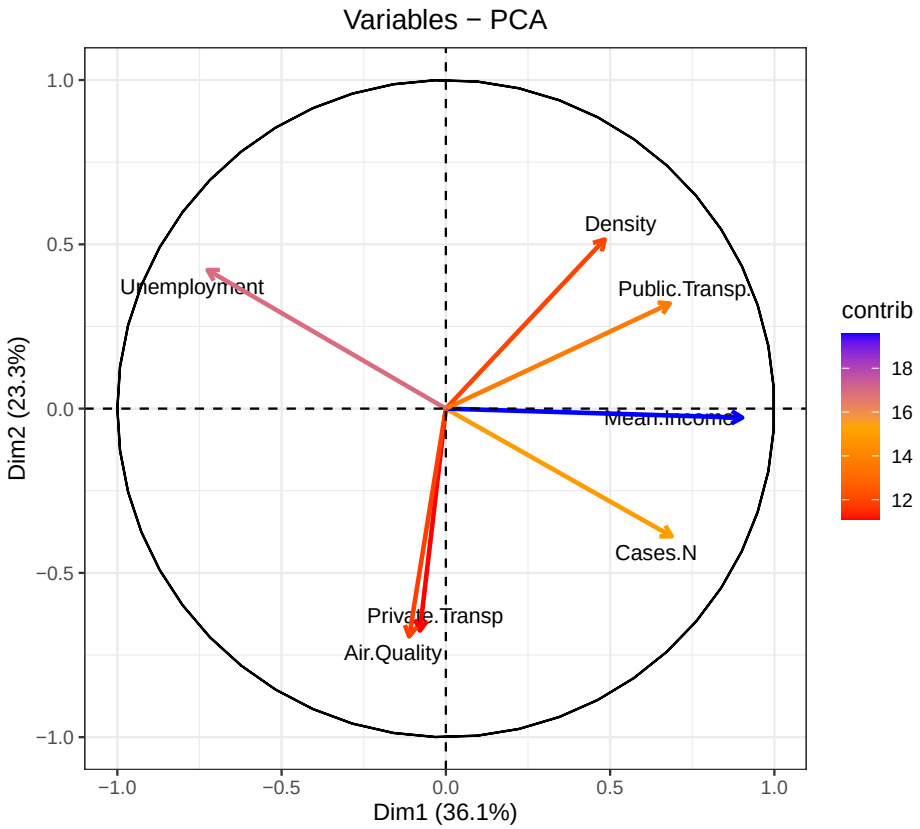
SOURCES: Protezione Civile, Istituto Italiano di Statistica, Ministro delle Finanze, Ministro della Salute, World Health Organization and World Bank

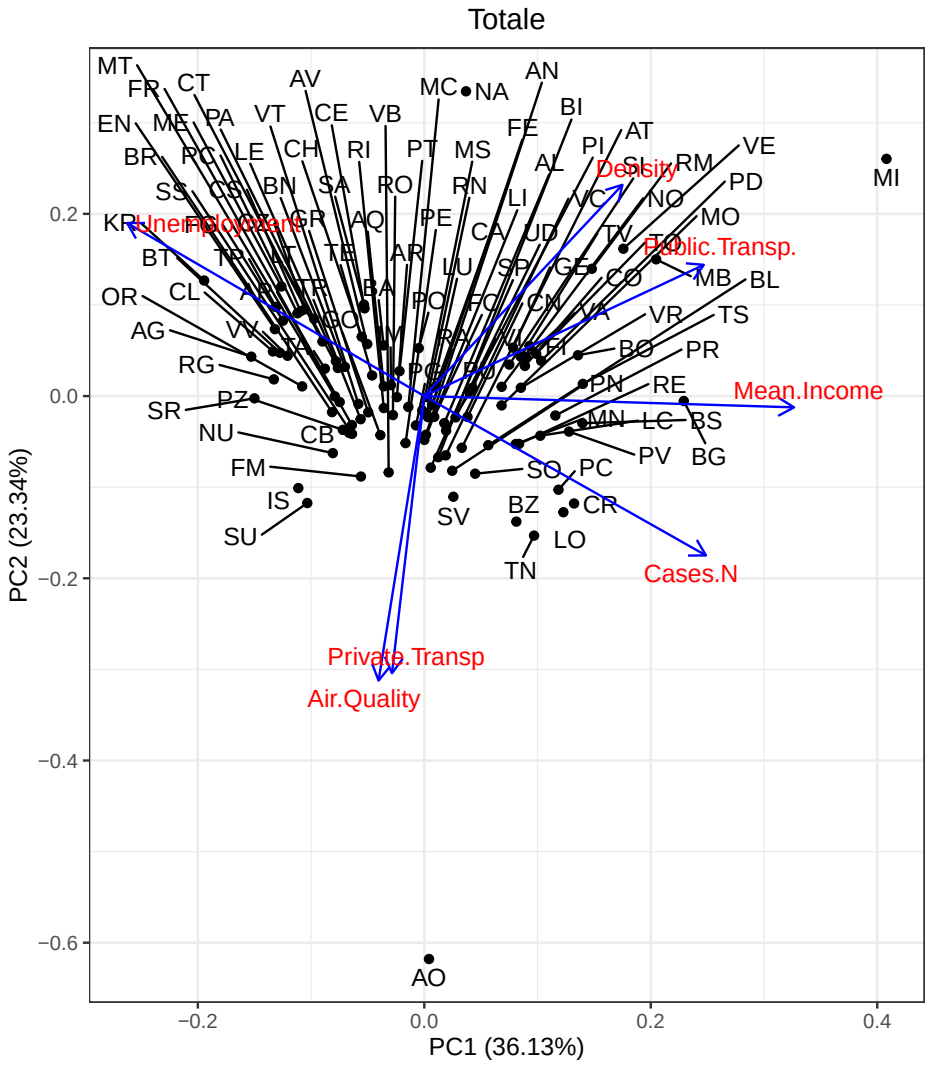
Provinces


Provinces
Unemployment
Private.Transp
Air.Quality
Public.Transp.
Density
Cases.N
Mean.Income

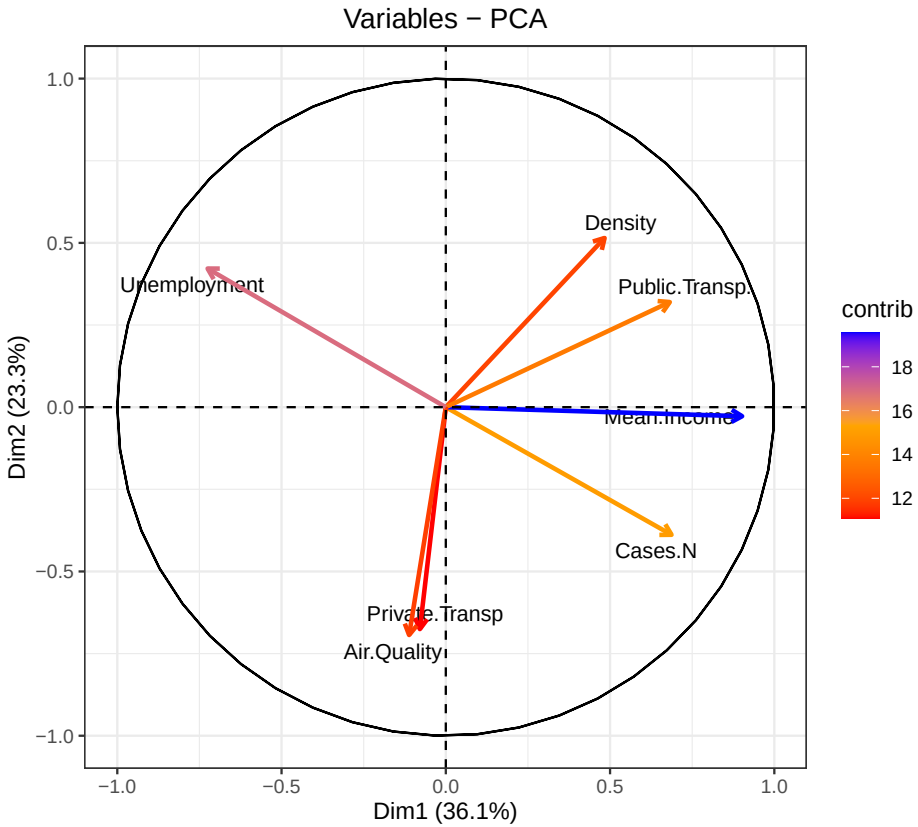

Variances − PCA
36.1%
23.3%
14.2%
9.2%
7.9%
5.5%
3.8%
% of variances
Principal Components

Provinces


Variables − PCA
Density
Unemployment
Public.Transp.
Mean.Income
Cases.N
Private.Transp
Air.Quality
contrib
18
16
14
12
Dim2 (23.3%)
Dim1 (36.1%)
1.0
0.5
0.0
−0.5
−1.0

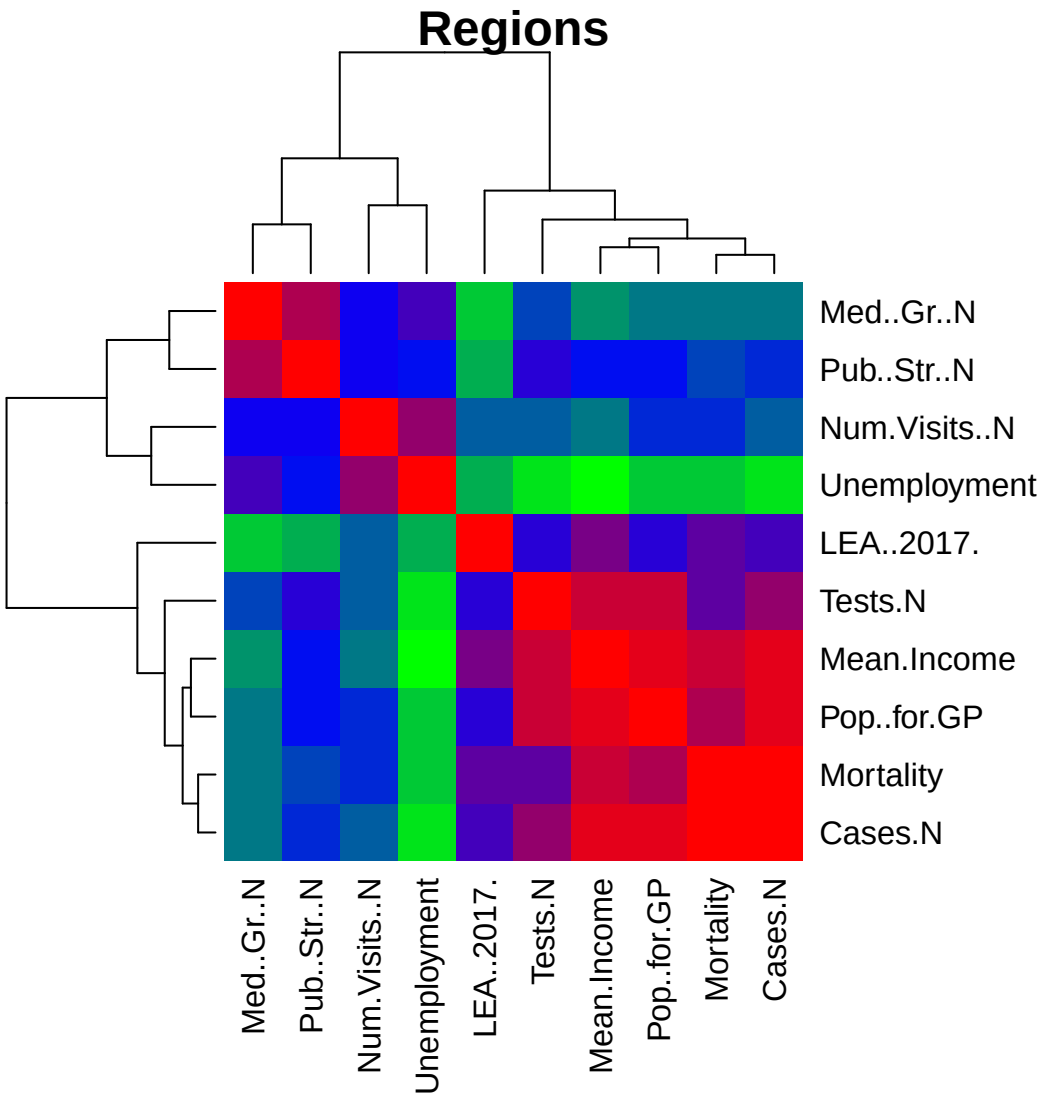

Totale
Density
Public.Transp.
Mean.Income
Cases.N
Private.Transp
Air.Quality
MI
AO
PC2 (23.34%)
PC1 (36.13%)
0.2
0.0
−0.2
−0.4
−0.6
0.4

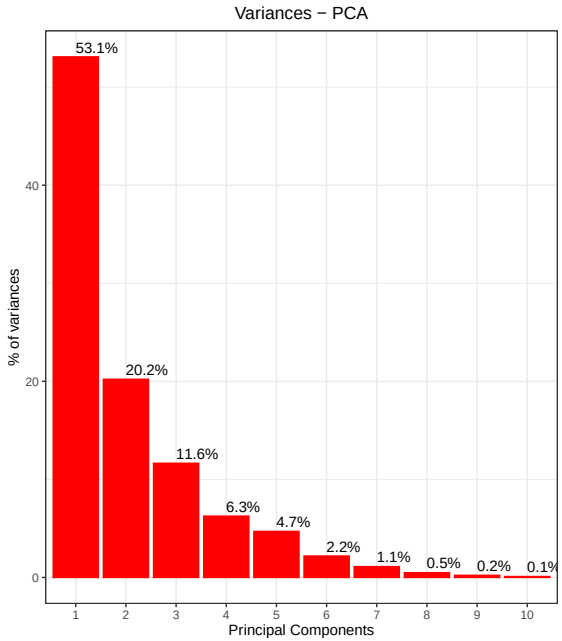
Provinces - Conclusions



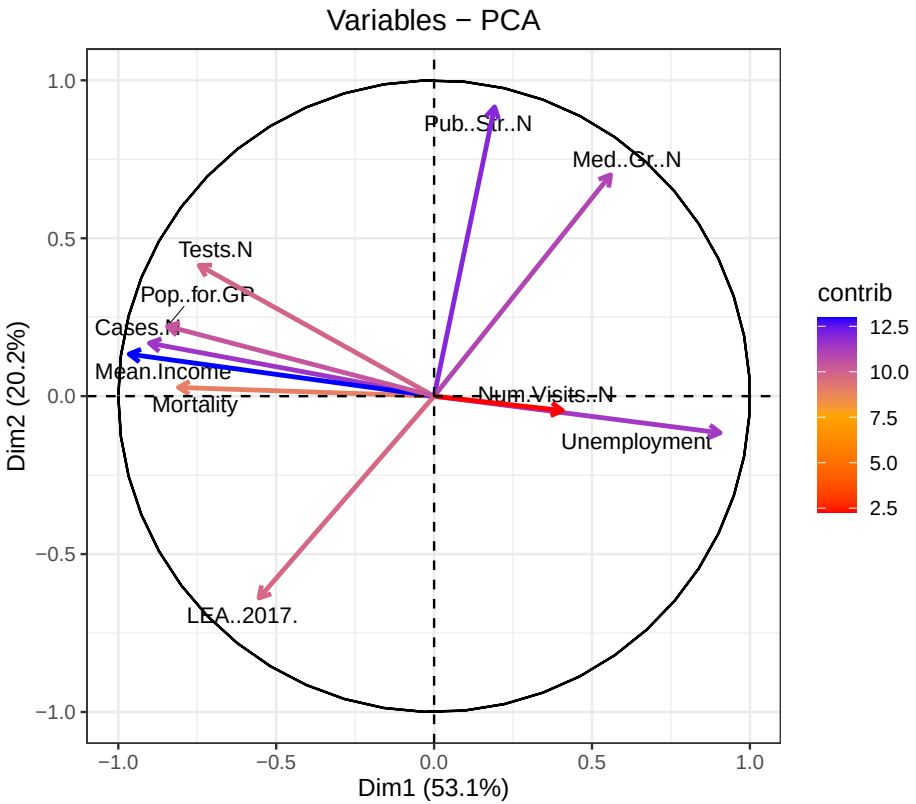
- The public transport, the density, the normalized cumulative cases and the mean income are positively correlated
- A higher density, a higher public transport demand and a higher income increase the rate of contact between the individuals [3, 2]
- Rich people can spend more money for social events or perhaps in to travels thus they increase their connectivity (the opposite happens for the unemployment)[4]

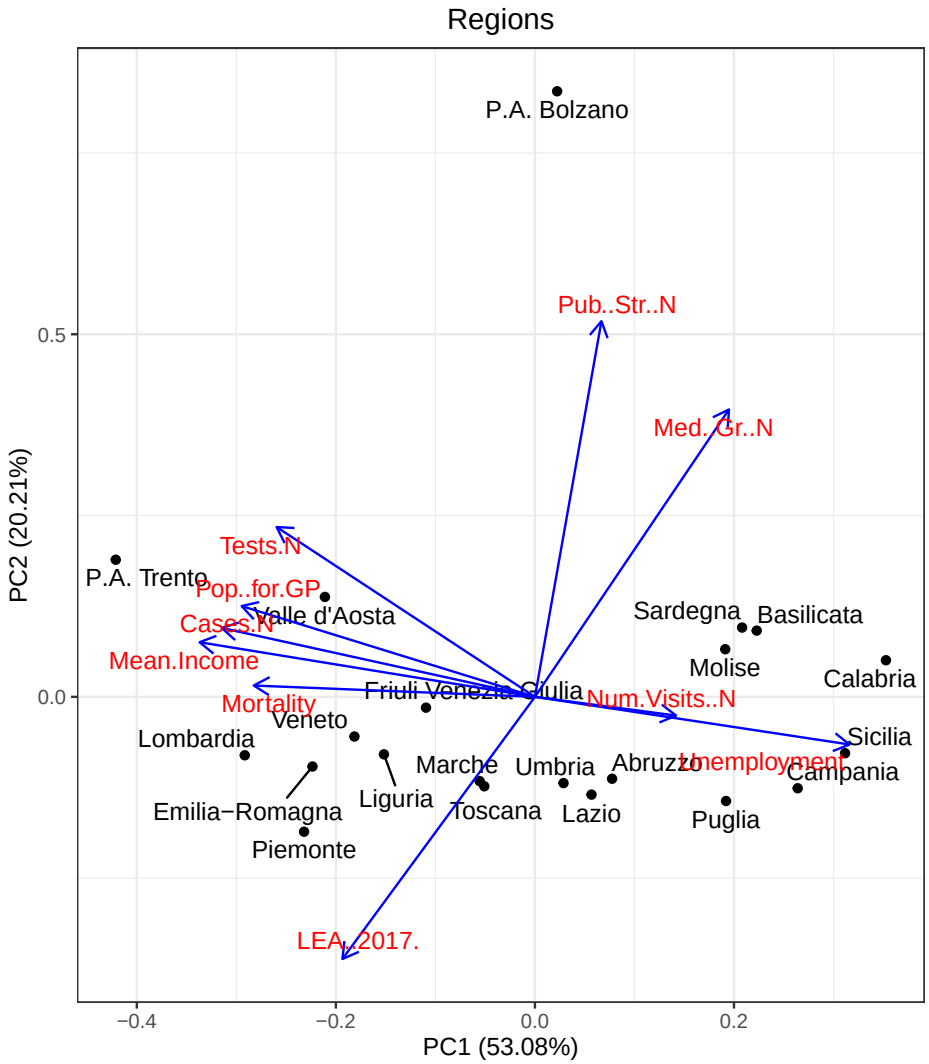
Regions


Regions
Med..Gr..N
Pub..Str..N
Num.Visits..N
Unemployment
LEA..2017.
Tests.N
Mean.Income
Pop..for.GP
Mortality
Cases.N

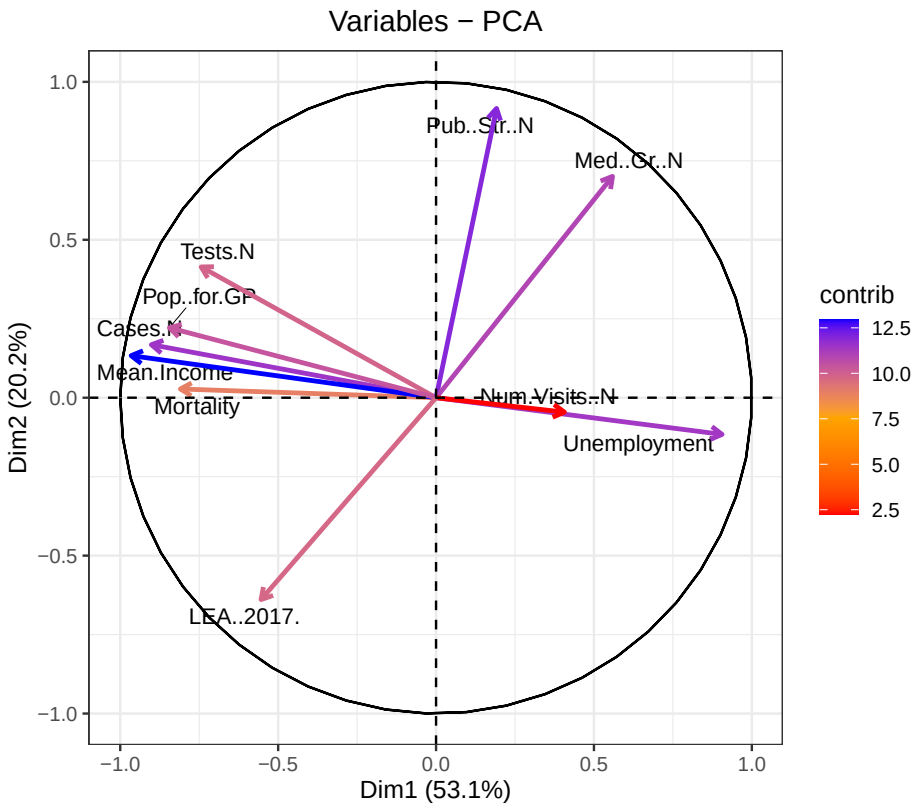

Variances − PCA
% of variances
Principal Components
53.1%
20.2%
11.6%
6.3%
4.7%
2.2%
1.1%
0.5%
0.2%
0.1%

Regions


Variables − PCA
Pub..Str..N
Med..Gr..N
Tests.N
Pop..for.GP
Cases.N
Mean.Income
Mortality
Num.Visits..N
Unemployment
LEA..2017.
contrib
12.5
10.0
7.5
5.0
2.5
Dim2 (20.2%)
Dim1 (53.1%)
1.0
0.5
0.0
−0.5
−1.0

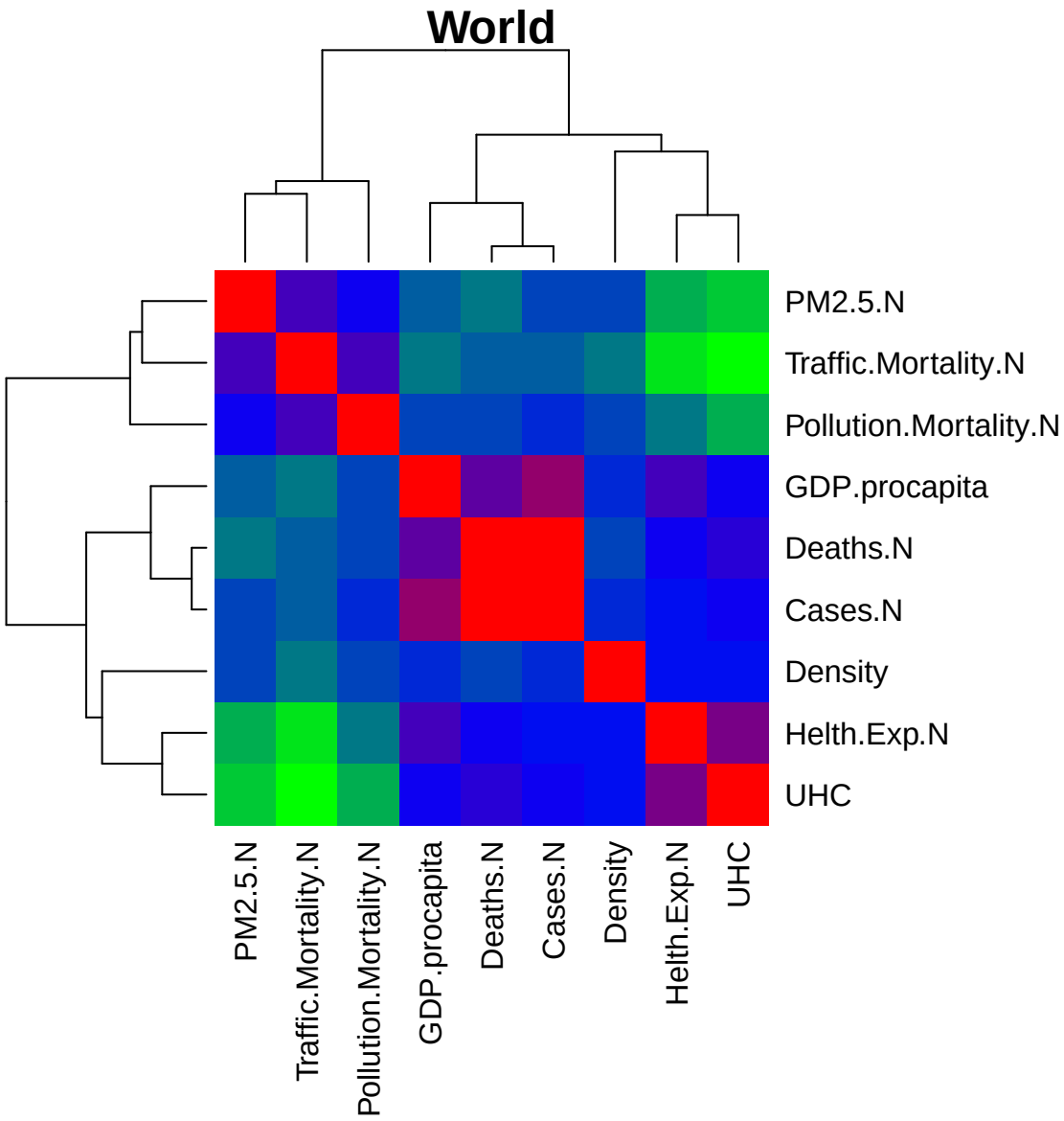

Regions
P.A. Bolzano
Pub..Str..N
Med..Gr..N
Tests.N
P.A. Trento
Pop..for.GP
Valle d'Aosta
Cases.N
Mean.Income
Mortality
Friuli Venezia Giulia
Num.Visits..N
Veneto
Lombardia
Sardegna
Basilicata
Molise
Calabria
Sicilia
Campania
Unemployment
Abruzzo
Marche
Umbria
Liguria
Toscana
Lazio
Puglia
Emilia−Romagna
Piemonte
LEA..2017.
PC2 (20.21%)
PC1 (53.08%)
0.5
0.0
−0.4
−0.2
0.0
0.2

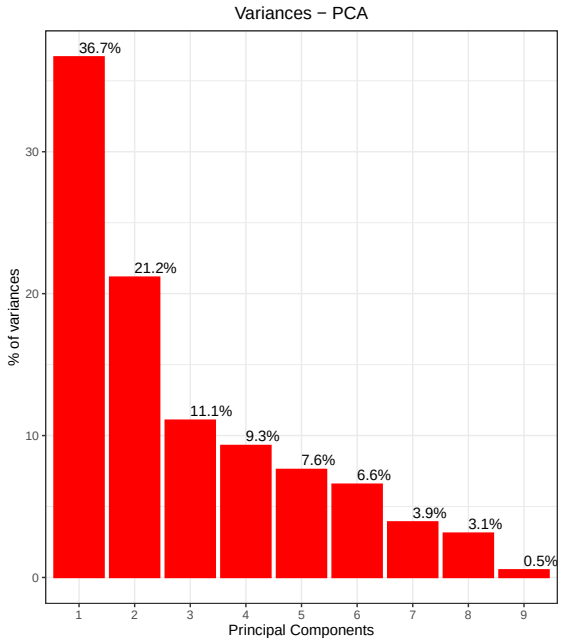
Regions - Conclusions



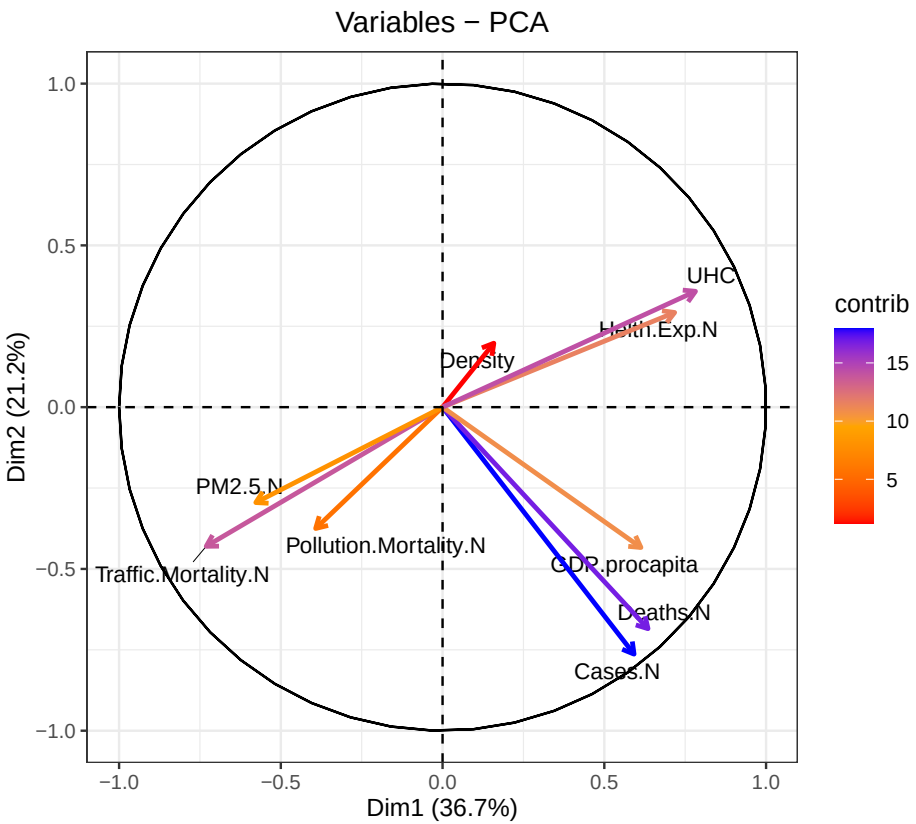
- Positive correlation between the number of people for general practitioner(GP) and the number of cases
- A higher number of normalized visit is negatively correlated with the number of cases and the mortality
- The GP play the role of sensor for the COVID-19 cases:if their number and their presence is reduced, the health service is less sensitive to find new cases and the diffusion of the virus is favoured [1]

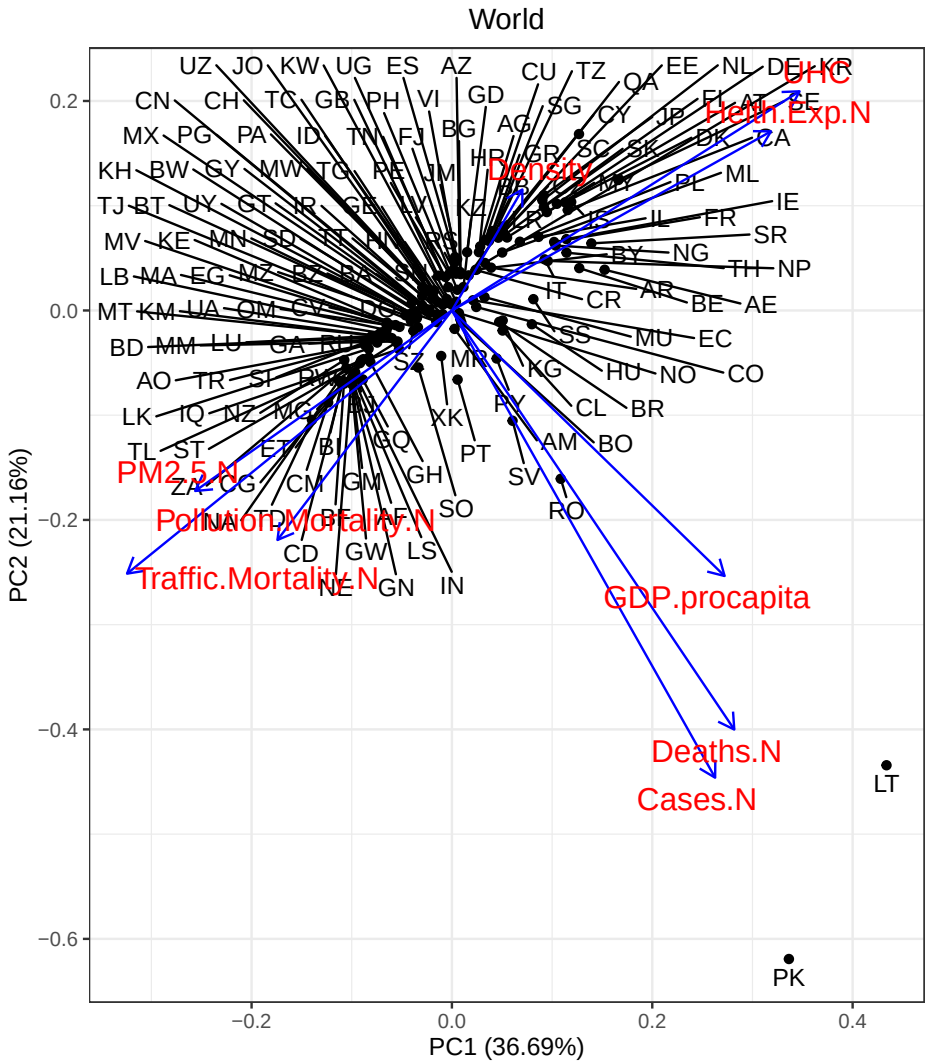
Countries


World
PM2.5.N
Traffic.Mortality.N
Pollution.Mortality.N
GDP.procapita
Deaths.N
Cases.N
Density
Helth.Exp.N
UHC

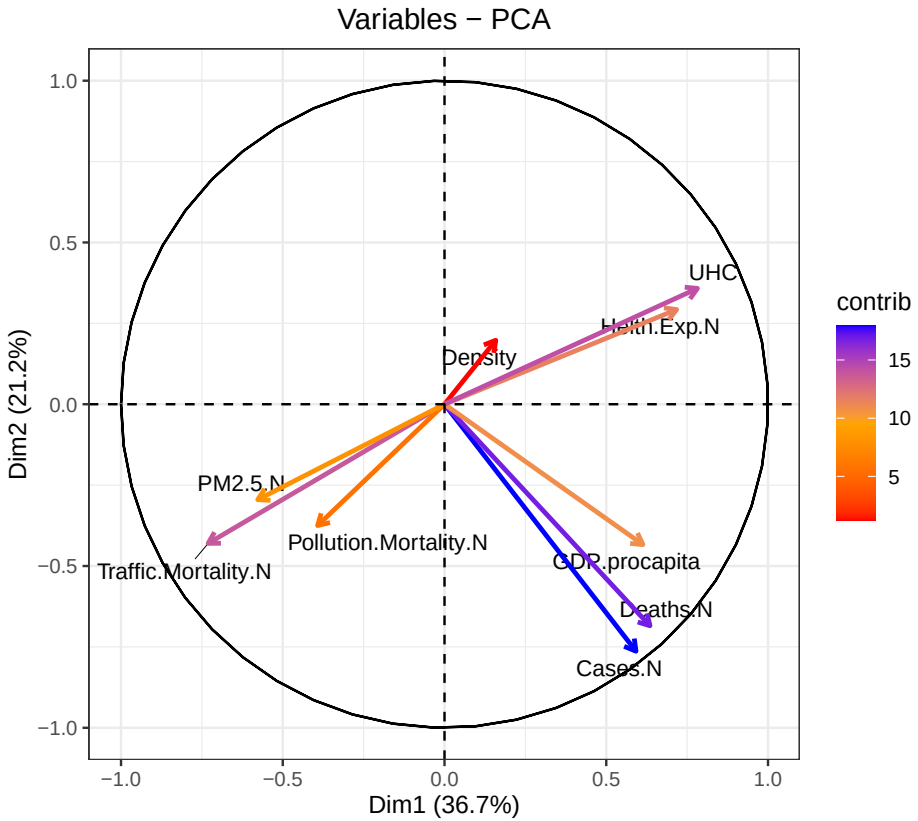

Variances − PCA
% of variances
Principal Components
36.7%
21.2%
11.1%
9.3%
7.6%
6.6%
3.9%
3.1%
0.5%

Countries


Variables − PCA
Dim2 (21.2%)
Dim1 (36.7%)
1.0
0.5
0.0
−0.5
−1.0
UHC
Health.Exp.N
Density
PM2.5.N
Pollution.Mortality.N
Traffic.Mortality.N
GDP.procapita
Deaths.N
Cases.N
contrib
15
10
5


World
PC2 (21.16%)
PC1 (36.69%)
0.2
0.0
−0.2
−0.4
−0.6
−0.2
0.0
0.2
0.4
UHC
Health.Exp.N
Density
PM2.5.N
Pollution.Mortality.N
Traffic.Mortality.N
GDP.procapita
Deaths.N
Cases.N
LT
PK

Countries - Conclusions



- The GDP pro-capita seems to be statistically correlated with the cases and the deaths
- A possible objection to this link can be that only the richest countries can invest money for the tests for the validation of a COVID19 case: however it can be noted from plots that the normalized health expenditure as well the UHC index are basically orthogonal with respect to the normalized COVID19 cases and deaths

References I

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World Health Organization. Centre for Health Development and World Health Organization. *Hidden cities: unmasking and overcoming health inequities in urban settings*. World Health Organization, 2010.

Carl-Johan Neiderud. "How urbanization affects the epidemiology of emerging infectious diseases". In: *Infection ecology & epidemiology* 5.1 (2015), p. 27060.

Simone Weyers et al. "Low socio-economic position is associated with poor social networks and social support: results from the Heinz Nixdorf Recall Study". In: *International Journal for Equity in Health* 7.1 (2008), p. 13.