

# Multivariate Analysis

Ana Rasinhas

Daniela Gonçalves

Pedro Fernandes

Ricardo Branco

Samuel Medalha

2025-12-03

## Abstract

## Introduction

## Methodology

```
Kaiser-Meyer-Olkin factor adequacy
Call: KMO(r = scaled_data)
Overall MSA =  0.86
MSA for each item =
trstprl trstlgl trstpplt trstpprt trstep trstun imbgeco imueclt imwbcnt
imsmetn
  0.92    0.93    0.82    0.83    0.86    0.85    0.93    0.90    0.89
  0.90
imdfetn impcntr eqwrkbg eqpolbg eqmgmbg eqpaybg
  0.83    0.87    0.91    0.79    0.77    0.89
```

After executing the Kaiser-Meyer-Olkin test, the MSA (measure of sampling accuracy, which varies between 0 and 1) is calculated as 0.86. This is classified as “meritorious”, so we have an indication that factor analysis is suitable for this data set.

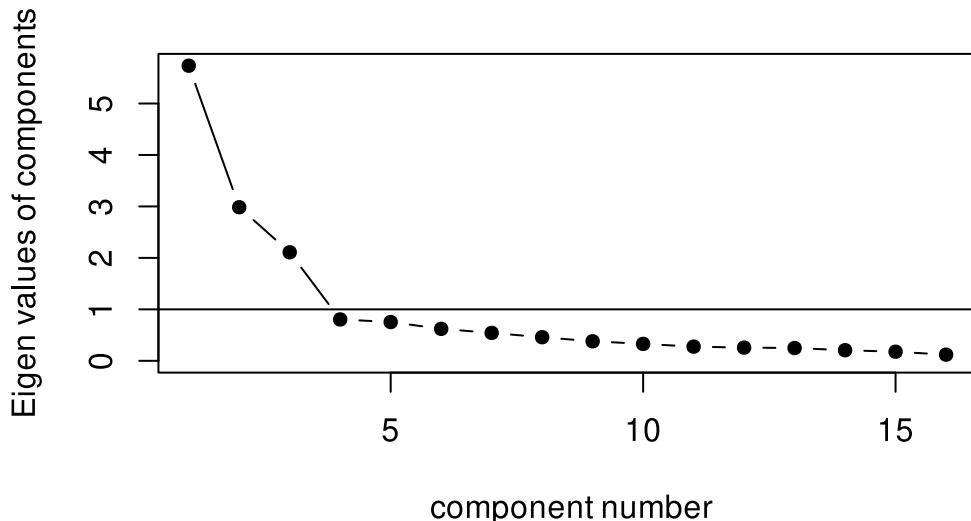
We'll start by performing factor analysis with a high number of values:

	RC2	RC3	RC4	RC5	RC9	RC6	RC10	RC7	RC12
SS loadings	2.667	1.908	1.859	1.090	1.046	1.003	0.977	0.964	0.932
Proportion Var	0.167	0.119	0.116	0.068	0.065	0.063	0.061	0.060	0.058
Cumulative Var	0.167	0.286	0.402	0.470	0.536	0.598	0.659	0.720	0.778
Proportion Explained	0.167	0.119	0.116	0.068	0.065	0.063	0.061	0.060	0.058
Cumulative Proportion	0.167	0.286	0.402	0.470	0.536	0.598	0.659	0.720	0.778
	RC8	RC1	RC13	RC11	RC15	RC14	RC16		
SS loadings	0.913	0.910	0.710	0.461	0.231	0.210	0.120		
Proportion Var	0.057	0.057	0.044	0.029	0.014	0.013	0.008		

Cumulative Var	0.835	0.892	0.936	0.965	0.979	0.992	1.000
Proportion Explained	0.057	0.057	0.044	0.029	0.014	0.013	0.008
Cumulative Proportion	0.835	0.892	0.936	0.965	0.979	0.992	1.000

	MR4	MR1	MR2	MR3	MR5	MR6	MR7	MR8	MR9
SS loadings	2.152	2.122	1.806	1.632	1.511	1.315	0.948	0.085	0.063
Proportion Var	0.135	0.133	0.113	0.102	0.094	0.082	0.059	0.005	0.004
Cumulative Var	0.135	0.267	0.380	0.482	0.576	0.659	0.718	0.723	0.727
Proportion Explained	0.182	0.180	0.153	0.138	0.128	0.111	0.080	0.007	0.005
Cumulative Proportion	0.182	0.362	0.515	0.653	0.781	0.893	0.973	0.980	0.985
	MR11	MR10	MR12	MR15	MR13	MR14	MR16		
SS loadings	0.061	0.047	0.025	0.018	0.013	0.009	0.000		
Proportion Var	0.004	0.003	0.002	0.001	0.001	0.001	0.000		
Cumulative Var	0.731	0.734	0.735	0.737	0.737	0.738	0.738		
Proportion Explained	0.005	0.004	0.002	0.002	0.001	0.001	0.000		
Cumulative Proportion	0.990	0.994	0.997	0.998	0.999	1.000	1.000		

## Scree plot



```

pcf_varimax <- principal(scaled_data, nfactors = 3, rotate = "varimax", scores = TRUE)
pcf_quartimax <- principal(scaled_data, nfactors = 3, rotate = "quartimax")
paf_varimax <- fa(scaled_data, nfactors = 3, rotate = "varimax")
paf_quartimax <- fa(scaled_data, nfactors = 3, rotate = "quartimax")
print(pcf_varimax$loadings, cutoff = 0.6, digits = 3)

```

```

Loadings:
      RC2     RC1     RC3
trstprl  0.846
trstlbl  0.742
trstplt  0.885
trstprrt 0.878
trstep   0.773
trstun   0.725
imbgeco      0.770
imueclt      0.770
imwbcnt      0.775
imsmetn      0.766
imdfetn      0.862
impctr      0.830
eqwrkbg      0.703
eqpolbg      0.853
eqmgmbg      0.872
eqpaybg      0.789

      RC2     RC1     RC3
SS loadings   4.129 3.980 2.719
Proportion Var 0.258 0.249 0.170
Cumulative Var 0.258 0.507 0.677

```

```
print(pcf_quartimax$loadings, cutoff = 0.6, digits = 3)
```

```

Loadings:
      RC2     RC1     RC3
trstprl  0.846
trstlbl  0.742
trstplt  0.885
trstprrt 0.878
trstep   0.773
trstun   0.725
imbgeco      0.772
imueclt      0.772
imwbcnt      0.777
imsmetn      0.768
imdfetn      0.865
impctr      0.832
eqwrkbg      0.702
eqpolbg      0.850
eqmgmbg      0.869
eqpaybg      0.786

```

```
          RC2   RC1   RC3  
SS loadings    4.130 4.017 2.681  
Proportion Var 0.258 0.251 0.168  
Cumulative Var 0.258 0.509 0.677
```

```
print(paf_varimax$loadings, cutoff = 0.6, digits = 3)
```

```
Loadings:  
          MR2   MR1   MR3  
trstprl 0.819  
trstlgl 0.670  
trstplt 0.879  
trstpprt 0.867  
trstep 0.717  
trstun 0.656  
imbgeco      0.720  
imueclt      0.724  
imwbcnt      0.727  
imsmetn      0.694  
imdfetn      0.843  
impctr       0.794  
eqwrkbg  
eqpolbg      0.833  
eqmgmbg      0.873  
eqpaybg      0.685  
  
          MR2   MR1   MR3  
SS loadings    3.780 3.580 2.364  
Proportion Var 0.236 0.224 0.148  
Cumulative Var 0.236 0.460 0.608
```

```
print(paf_quartimax$loadings, cutoff = 0.6, digits = 3)
```

```
Loadings:  
          MR2   MR1   MR3  
trstprl 0.819  
trstlgl 0.670  
trstplt 0.879  
trstpprt 0.867  
trstep 0.717  
trstun 0.655
```

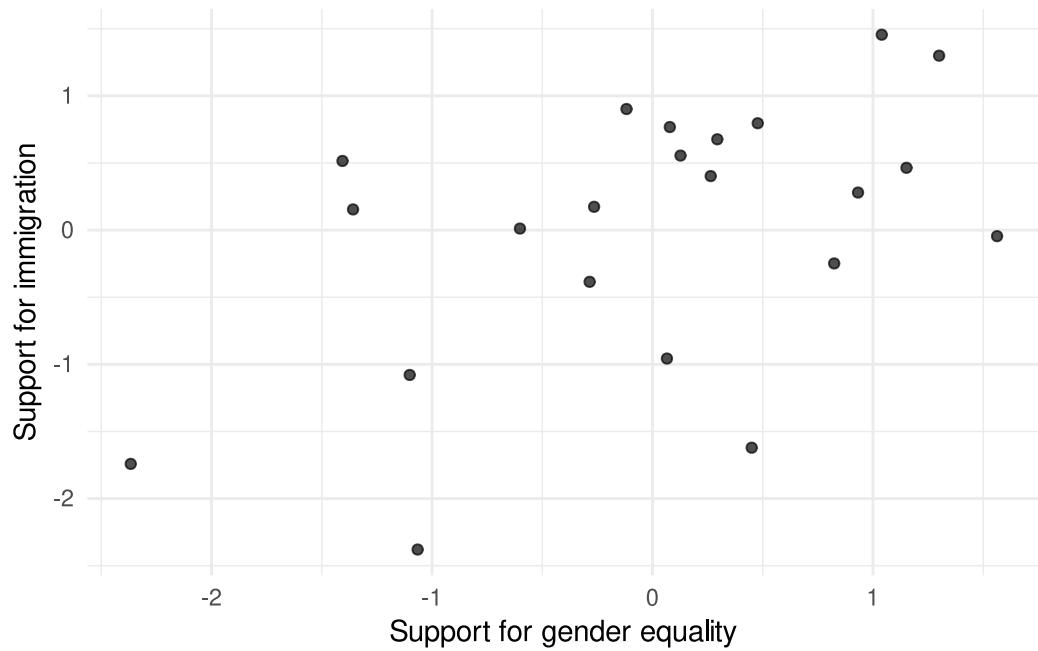
```

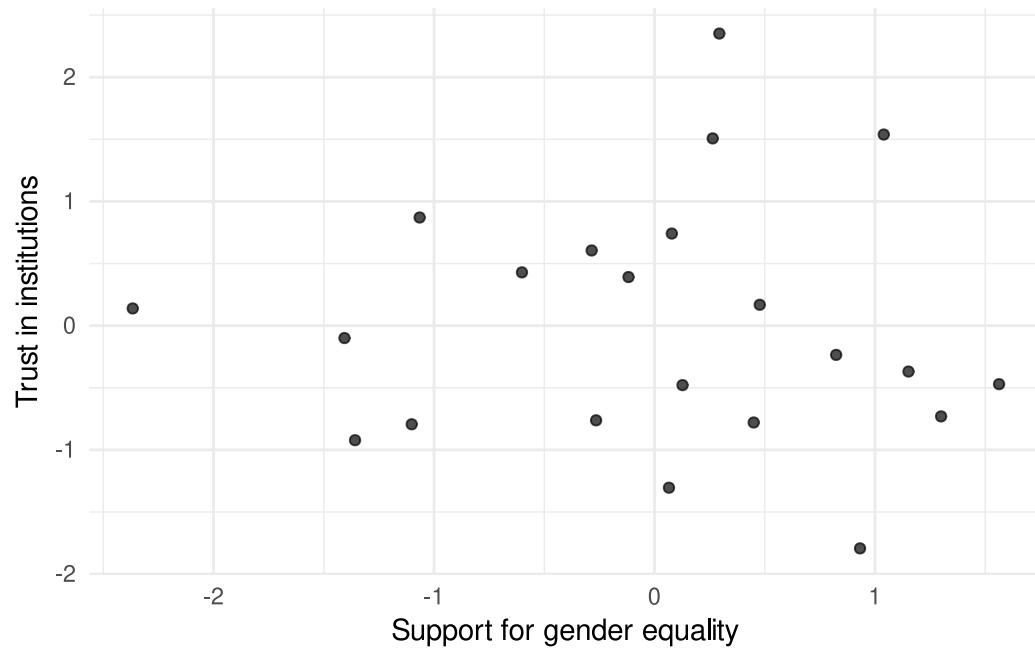
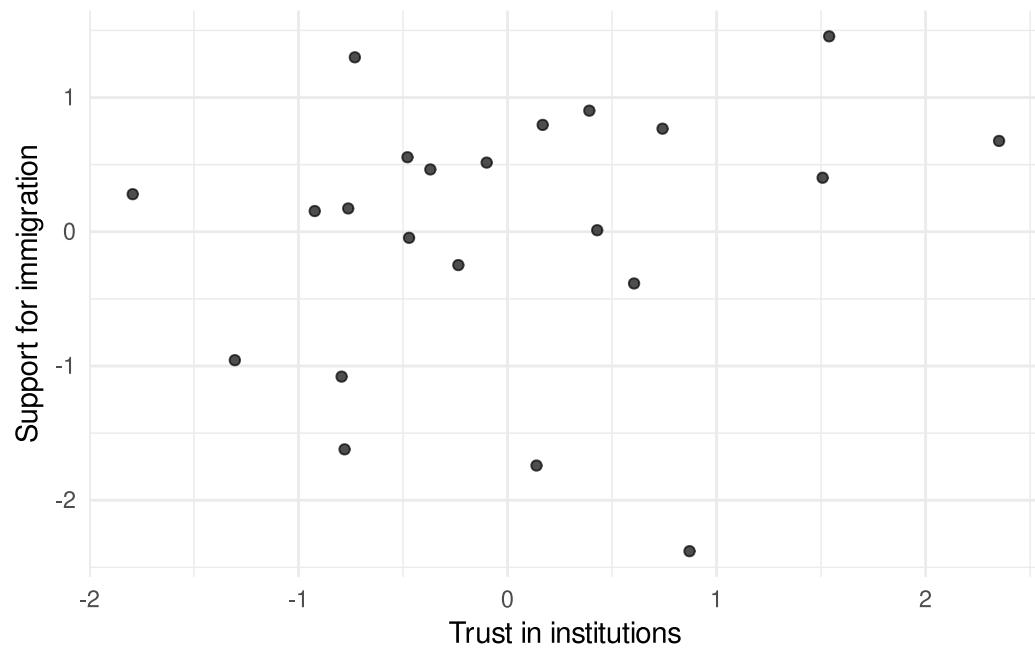
imbgeco      0.723
imueclt      0.728
imwbcnt      0.729
imsmetn      0.697
imdfetn      0.848
impctr       0.799
eqwrkbg
eqpolbg        0.828
eqmgmbg        0.868
eqpaybg        0.680

          MR2    MR1    MR3
SS loadings   3.777  3.646  2.300
Proportion Var 0.236  0.228  0.144
Cumulative Var 0.236  0.464  0.608

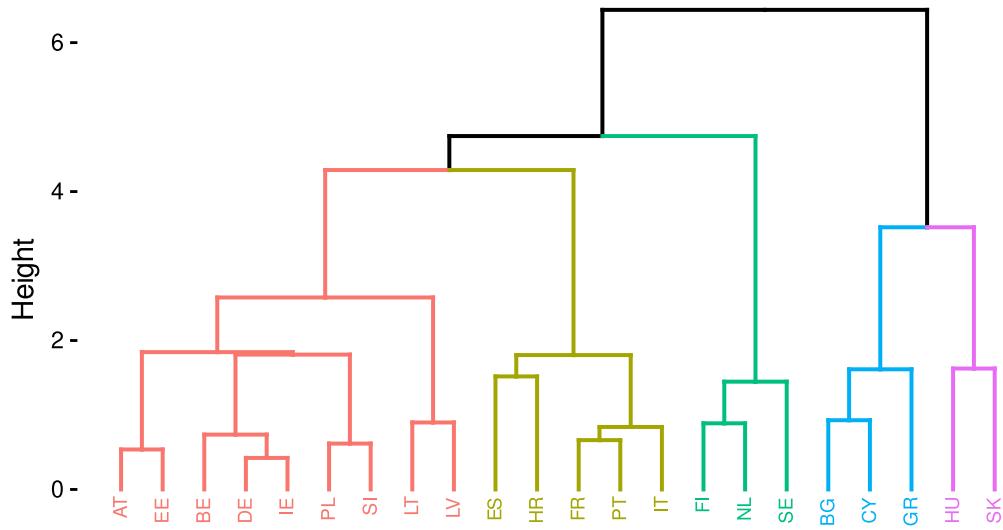
```

Explicar porque standardizamos a média das observações para cada país .





### Cluster Dendrogram



Ver várias métricas?

## Results

## Discussion

## Conclusions

## References