DIMENSIONALITY REDUCTION IN R

Rotating Factors

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Steps to perform EFA

- Check for data factorability

- Extract factors

- Choose the "right" number of factors to retain

- **Rotate factors**

- **Interpret the results**

Factor rotation in EFA

Why further rotate the factors?

- To ease interpretation

- **Orthogonal** methods

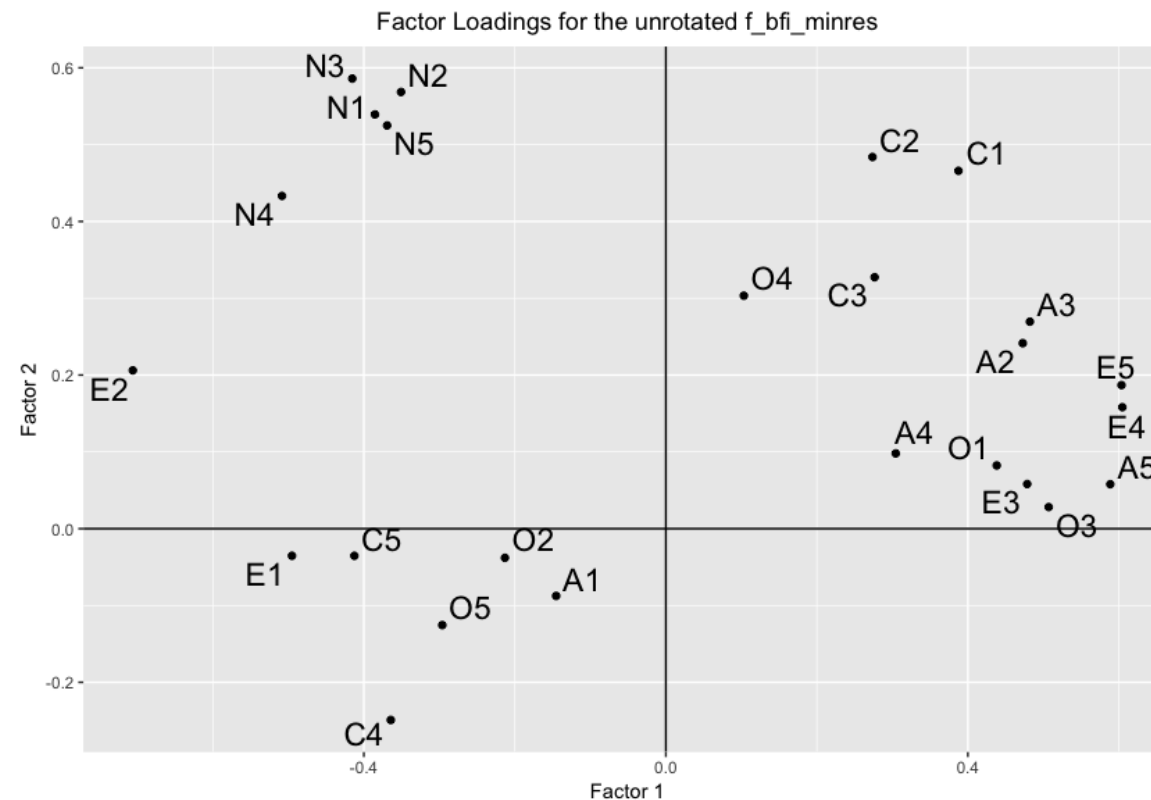   - Quartimax

    - Equimax

    - **Varimax**

- **Oblique** methods

    - Direct Oblimin

    - Promax

Plotting unrotated factor loadings

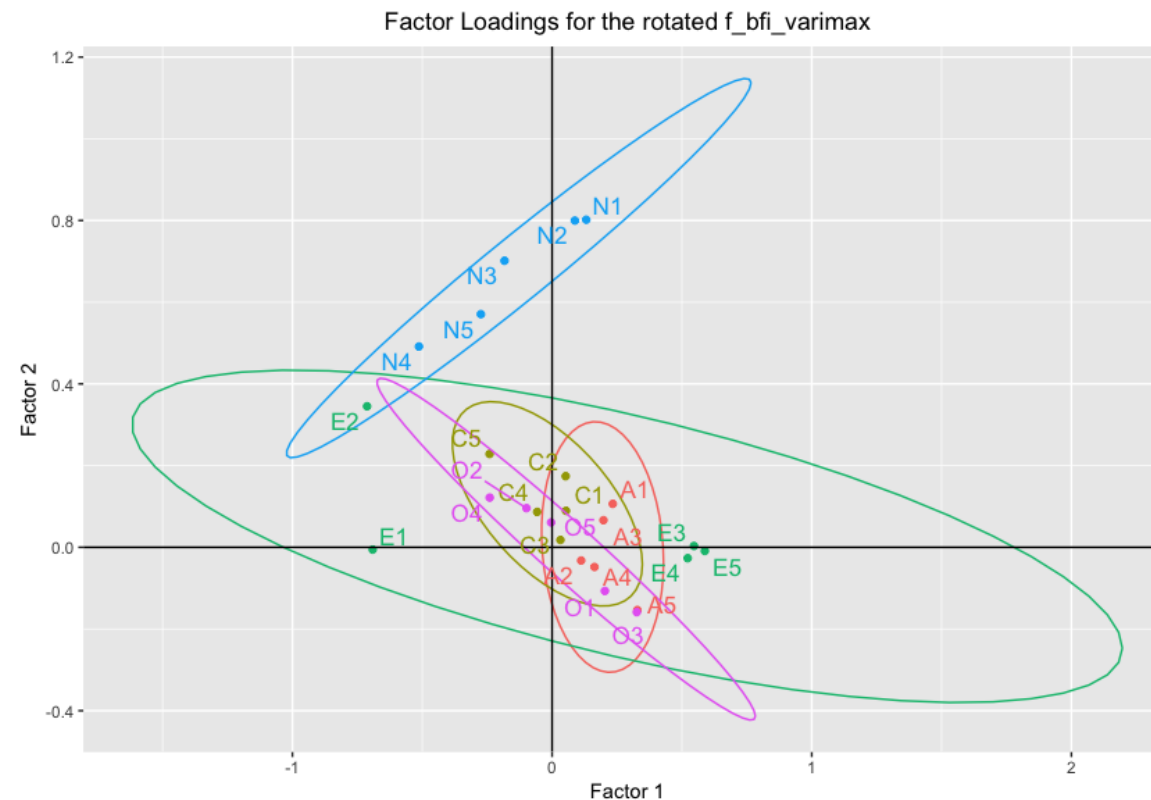**5** putative factors behind the 25 self report items:

- **A**greeableness (A1,A2,A3,A4,A5)

- **C**onscientiousness (C1,C2,C3,C4,C5)

- **E**xtraversion (E1,E2,E3,E4,E5)

- **N**euroticism (N1,N2,N3,N4,N5)

- **O**penness (O1,O2,O3,O4,O5)

Factor Loadings for the unrotated f_bfi_minres

Rotating with varimax

```
# Applying varimax.
f_bfi_varimax <- fa(bfi_c,
                    fm = "minres",
                    nfactors = 5,
                    rotate = "varimax")
```

- **E1**: "Don't talk a lot"

- **E2**: "Find it difficult to approach others"

- **E3**: "Know how to captivate people"

- **E4**: "Make friends easily"

- **E5**: "Take charge"

Factor Loadings for the rotated f_bfi_varimax

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Let's practice!

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Path diagrams

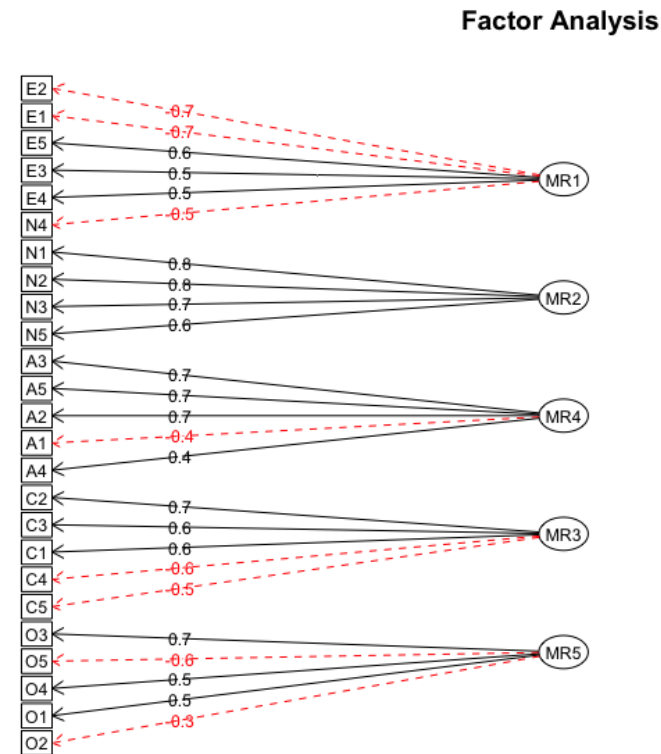## Alexandros Tantos

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Interpretation: a crucial part of EFA

```r
library(psych)

# Creating the path diagram.
fa.diagram(f_bfi_varimax)
```

- **A**greeableness (A1,A2,A3,A4,A5)

- **C**onscientiousness (C1,C2,C3,C4,C5)

- **E**xtraversion (E1,E2,E3,E4,E5)

- **N**euroticism (N1,N2,N3,N4,N5)

- **O**penness (O1,O2,O3,O4,O5)

Factor Analysis

Interpretation: a crucial part of EFA

```
# Checking out factor loadings.
print(f_bfi_varimax$loadings, cut=0)
```

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EFA: case study

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The Short Dark Triad

- A dataset that resulted from measuring the 3 *dark* personality traits:

  - machiavellianism (a manipulative behaviour),

  - narcissism (excessive self-admiration), and

  - psychopathy (lack of empathy)

(Interactive version of the test: https://openpsychometrics.org/tests/SD3/)

The SD3 dataset

```
sdt_test <- read.csv("SD3.csv", sep = "\t")
dim(sdt_test)
```

[1] **18192 29**

```
head(sdt_test)
```

	M1	M2	M3	M4	M5	M6	M7	M8	M9	N1	N2	N3	N4	N5	N6	N7	N8	N9	P1	P2	P3	P4	P5	P6	P7	P8	P9	country	source
1	4	4	4	4	4	4	4	3	4	2	4	2	3	4	4	2	3	4	3	4	3	2	4	4	4	4	4	GB	1
2	2	1	5	2	2	1	2	2	3	1	5	1	1	5	5	1	5	2	1	1	1	5	4	1	5	3	2	US	1
3	3	3	3	5	1	1	5	5	3	2	5	1	1	1	5	1	5	5	3	5	3	1	3	1	2	3	1	US	1
4	5	5	4	5	5	5	5	5	5	1	5	5	5	1	5	1	5	5	1	5	2	5	5	5	1	5		GB	3
5	4	4	2	5	5	5	4	1	4	3	4	3	1	5	4	3	2	5	4	5	3	1	4	3	5	4	1	GB	3
6	4	2	2	4	2	3	5	2	2	2	5	2	2	2	4	1	3	5	3	5	4	4	2	2	1	1	5	IT	1

EFA: The steps

- Check for data factorability

- Extract factors

- Choose the "right" number of factors to retain

- Rotate factors

- Interpret the results

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Overview of the course

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Dimensionality Reduction: the bigger picture

Biggest challenge of handling high-dimensional data:

- data interpretability

- remove noise and keep a reduced, interpretable representation

PCA and N-NMF

PCA

- **mathematically-sound** method

- suitable for **continuous data**

N-NMF

- **computationally efficient** (suitable for images and big data manipulation

- suitable for data with **positive entries**

EFA

EFA

- **exploratory** method

- suitable for **ordinal data**

- discovering underlying latent constructs

Common steps in practicing dimensionality reduction

- Factor/Component/Dimension extraction

- Decision on the number of Factor/Component/Dimension to retain

  - parsimonious representation

  - least information loss

  - most interpretable representation

- Use visual aid for interpretation (e.g. biplot)

Where to go from here? My two cents..

- Deepen your freshly-acquired `R` knowledge

  - `FactoMiner, factoextra, NMF, psych, ...`

- Test alternative packages for performing these methods

  - `stats, ade4, amap, ca, MASS`

- Extend your theoretical knowledge on commonly used notions:

  - eigenvalues, eigenvectors, orthogonality (for starters)

- Explore more dimensionality reduction methods

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Good luck!