# Hello R!
# An Introduction to R

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www.han.nl/masterscourses

## Who R we?

**Eghe Osagie**
- Assistant lector (professor) at HAN University of AS
- Lecturer Bachelor HRM, Master HRM, Master CE
- Coordinator Minor HR Analytics
- ***Interests:*** HR Analytics, Sustainability, HRM, Research methodology

**Witek ten Hove**
- Instructor at HAN University of AS
- Coordinator of MSI
- ***Interests:*** Business Economics, Data Engineering, Data Mining, AI, Web Dev.

## Programma

1. Intro R
2. Practicum
3. Confirmatory factor analysis

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# Link naar alle docs:

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# Intro R

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## R - software

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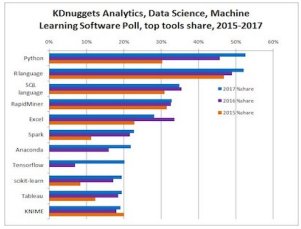


- Ranking second as tool for data science (after Python)
- Upcoming tool in Social sciences!
- Rule of Thumb: Play with the R program before you work on anything professional and know your data !!

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## Characteristics R

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- **Created in:** 1995 by Ross Ihaka & Robert Gentleman at the University of Auckland
- **Free**
- Computer language
- Windows, Mac, Linux
- and object oriented

- **Extending software via '*packages*'**
- Each package is maintained and supported by the author, but not warranted (!)
- CRAN checks report any potential notes, warnings, and errors associated with a package
- **Numerous Output options**

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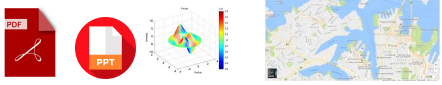




## Who can read this?

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**Command 1:**

```
install.packages("threejs")
library(threejs)
data(ego)
graphjs(ego, bg="black")
```


**Command 2:**

```
HS.model <- ' Visual   =~ x1 + x2 + x3
             Textual =~ x4 + x5 + x6
             Speed   =~ x7 + x8 + x9 '
```

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## Analysing with R

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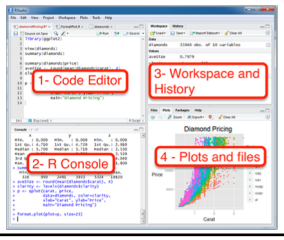
1. **Install R**
2. **Install R-studio – of rstudio.cloud**
3. **Set working directory**
4. **Save workspace**
5. **Install packages**
6. **Read tutorial**
7. **Amend commands**

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## Examplary Packages

| Package | description |
|---|---|
| LAVAAN | Latent Variable Analysis (SEM,CFA) |
| AcousticNDLCodeR | Coding Sound Files for Use with NDL |
| abd | The Analysis of Biological Data |
| RQDA | R-Based Qualitative Data Analysis |
| RSmartlyIO | Loading Facebook and Instagram Advertising Data from 'Smartly.io' |
| qdap | Bridging the Gap Between Qualitative Data and Quantitative Analysis |
| qha | Qualitative Harmonic Analysis |
| quanteda | Quantitative Analysis of Textual Data |

**See for more packages:**
https://cran.r-project.org/web/packages/available_packages_by_name.html

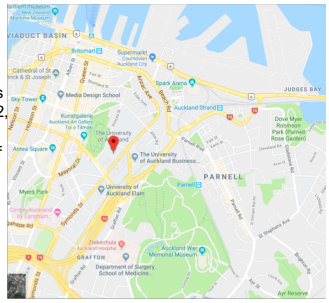
## Examplary output

**Copy paste command in R**

```
install.packages("leaflet");
library(leaflet);

m <- leaflet() %>% addTiles() %>% #
Add default OpenStreetMap map tiles
addMarkers(lng=174.768, lat=-36.852,
label= "The birthplace of R",
labelOptions = labelOptions(noHide =
T));

m # Print the map
```




## Amending commands

**Replace red…….**

```
install.packages("leaflet");
library(leaflet);
m <- leaflet() %>% addTiles() %>% #
Add default OpenStreetMap map tiles
addMarkers(lng=174.768, lat=-36.852,
label= "The birthplace of R",
labelOptions = labelOptions(noHide =
T))
m # Print the map
```

**….with green.**

```
install.packages("leaflet");
library(leaflet);
m <- leaflet() %>%
addTiles() %>%  # Add default
OpenStreetMap map tiles
addMarkers(lng= 5.949481,
lat=51.989683, label= "An introduction
to R", labelOptions =
labelOptions(noHide = T))
m  # Print the map
```

LET OP: Google maps toont eerst "Lng" en dan "Lat", dus net andersom invoeren.

## Examplary output

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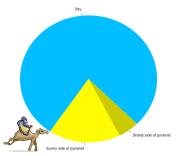
**Copy paste command in R**

```
pie(c(a=78, b=17, c=5), init.angle =
315, col = c("deepskyblue", "yellow",
"yellow3"), border = FALSE, radius =
1.0)
```



**Copy paste command in R**

```
install.packages("threejs")
library(threejs)
data(ego)
graphjs(ego, bg="black")
```

**More examples:**
https://github.com/witusj/hellor/blob/master/hellor.Rmd

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# Practicum R

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## Practicum

**Go to:** witusj.github.io/WorkshopSI/

**Perform the following exercises:**
- Voorbereiding
- Basis R

**Remaining exercises can be performed at home**

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# Hello R!

**This presentation can be found online:**

witusj.github.io/hellor/hellor.html
*press F for fullscreen*

**For the Workshop R (Dutch) go to:**
witusj.github.io/WorkshopSI/

**Workshop documents can be found here (docs folder):**
https://github.com/witusj/hellor/tree/master/docs

## Who can read this?

**Command 1:**

- install.packages("threejs")
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- graphjs(ego, bg="black")


**Command 2:**

```
HS.model <- ' Visual   =~ x1 + x2 + x3
              Textual =~ x4 + x5 + x6
              Speed   =~ x7 + x8 + x9 '
```

# Confirmatory Factor Analysis (Dutch)

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## CFA

**Doel confirmatory factor analysis:**
bevestiging krijgen voor van te voren bepaald model/structuur

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## CFA model:

De afbeelding kan niet worden weergegeven.

- **Kenmerken:**
  - **NIET** elke manifeste variabele een lading op elke factor
  - **WEL** relatie tussen de componenten
  - **WEL** meetfouten

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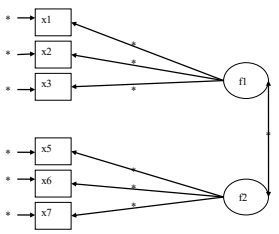
## CFA model:




**De asterixen** verwijzen naar de te schatten parameters

**Parameters =** die delen van het model die nog onbekend zijn voor de onderzoeker, en dus berekend moeten worden

**Hier:**
- meetfouten,
- factorladingen,
- correlaties tussen factoren,
- variantie van factoren,
- …

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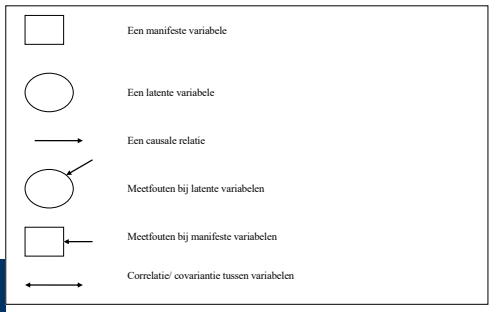
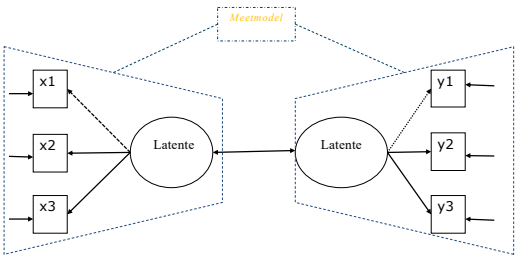
## Belangrijke bergippen in CFA

- **Rondje** = niet direct gemeten (latente var. [f])
- **Vierkant** = direct gemeten (manifeste var./indicator/item [x])
- ***ind.*** = indicator[x]
- → = impact van 1 variabele/factor op een andere variabele/factor
- ↔ = covariantie of correlatie tussen variabelen/factoren.
- ***Meetmodel*** = relatie tussen latente variabelen en indicatoren
- ***Structuurmodel*** = relaties tussen latente variabelen
- ***EXO*** = Exogene construct/factor (pijltje exit)
- ***e*** = meetfout

## Notatie voor tekenen van modellen



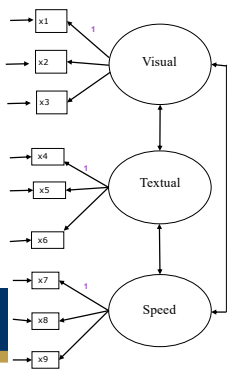

## Voorbeeld model CFA



## Belangerijke Commands LAVAAN

| Formule type | Operator | Betekenis |
|---|---|---|
| • Definitie van latente variabele | =~ | Is measured by/ Is gemeten door |
| • regressie | ~ | Is regressed on |
| • (residu) (co)variantie | ~~ | Is correlated with/ gecorrooleerd met |
| • intercept | ~1 | intercept |
| | f | Latente variabele |
| | y | Afhankelijke var |
| | x | Onafhank. Var/observed variable/indicator |
| | cfa() | Voer een CFA analyse uit. Met help("cfa"), krijg je uitleg over de functie |
| | sem() | Voer een SEM analyse uit. Met help("sem"), krijg je uitleg over de functie |
| | Growth() | Voer een Growth curve analyse uit. Met help("growth"), krijg je uitleg over de functie |

## Voorbeeld met LAVAAN in R




**1. Bepaal model(len)**
Visual =~ x1 + x2 + x3
Textual =~ x4 + x5 + x6
Speed =~ x7 + x8 + x9

Wat staat hier: Latent variable =~ indicator1 + indicator2 + indicator3

**2. Specificeer model(len) in R**
HS.model <- ' Visual =~ x1 + x2 + x3
Textual =~ x4 + x5 + x6
Speed =~ x7 + x8 + x9 '

**3. Fit model(len) in R**
…<- cfa (…., data = …….)

Bijv.: fitM1 <- cfa (HS.model, data = HolzingerSwineford1939)

**4. Lees Fit indices af/vergelijk ze**
summary (…, fit.measures = TRUE )

Bijv.: summary (fit, fit.measures = TRUE )

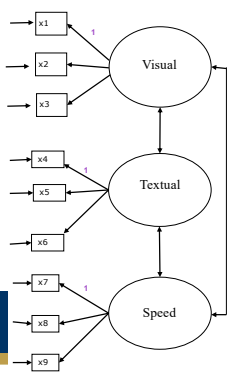
In het geval van niet normal verdeelde data en n>200+ (estimator MLM test = SB):
fitM1 <- cfa(HS.model, data = HolzingerSwineford1939, estimator= "MLM", test = "satorra.bentler")

Mocht je specifieke fitmaken willen opvragen:
fitMeasures(fitM1, c("cfi.scaled", "rmsea", "gfi", "agfi", "nnfi", "chisq", "chisq.scaled", "df.scaled") )

Voor de modificatie indeces:
modindices(fitM1)

Rood = aanpassen aan eigen variabelen/items/namen

## Voorbeeld met LAVAAN in R

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Bijv.: fitM1 <- cfa (HS.model, data = HolzingerSwineford1939)

**4. Lees Fit indices af/vergelijk ze**
summary (…, fit.measures = TRUE )

Bijv.: summary (fit1, fit.measures = TRUE )

**5. Bepaal beste model nadat je meerdere modellen hebt gefit**

anova(fit1,fit3)

Kijk naar AIC waarde…lagere AIC of chi kwardaat is beter model

Rood = aanpassen aan eigen variabelen/items/namen

## Fit indices

| Fit indices | Tresholds (cut-offs) |
|---|---|
| • Relative Chi square (Chi-square-df; cmin/df) | < 2[a] of <3= good[b] (soms is <5 ook toegelaten[c]) |
| • p value of the model | >.05 |
| • RMSEA | <.05=good; .05-.10=moderate; >.10=bad[b] |
| • CFI | >.95=great; >.90 tradtitional; >.80 sommige gevallen toelaatbaar[b]…..streven >.93[d] |
| • GFI | >.90[d]…liefst >.95[b] |
| • (N)NFI | >.90[d]…of >.95[c] |
| • AGFI | >.80[b] |

a = Ullman(2001). b = Hu & Bentler (1999). c = Schumacker & Lomax (2004). d = Byrne (1994)

## Modification indices (MI) & Standardized residuals covar (SRC)

***Aanpassen model*** : doe je bij geen goede fit. Theoretische onderbouwing belangrijk!!

- ***Theorie***
- ***MI***
  - Error van verschillende constructen mogen niet correleren
  - Error mag niet correleren met latente of observerd constructen
- ***SRC***
  - Error van verschillende constructen mogen niet correleren
  - Error mag niet correleren met latente of observerd constructen

## MI rules

De afbeelding kan niet worden weergegeven.

## CFA samengevat

- *CFA om model-fit te schatten*: past model bij de data? => fit indices: Chi², GFI, AGFI, NNFI, CFI, RMSEA
- *CFA om modellen onderling te vergelijken*: kijk naar AIC waarde, lagere waarde dan past model beter bij data
- *En hoe het model interpreteren*? => interpreteren van parameterschattingen

## Practicum

- **CFA→** open Tutorial LAVAAN, perform excises on p. 4-8

**Remaining exercises can be performed at home**

## Questions?