Hogeschool van Arnhem en Nijmegen
HAN University of Applied Sciences

Hello R!
An Introduction to R

Eghe Rice Osagie
(eghe.osagie@han.nl)

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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.

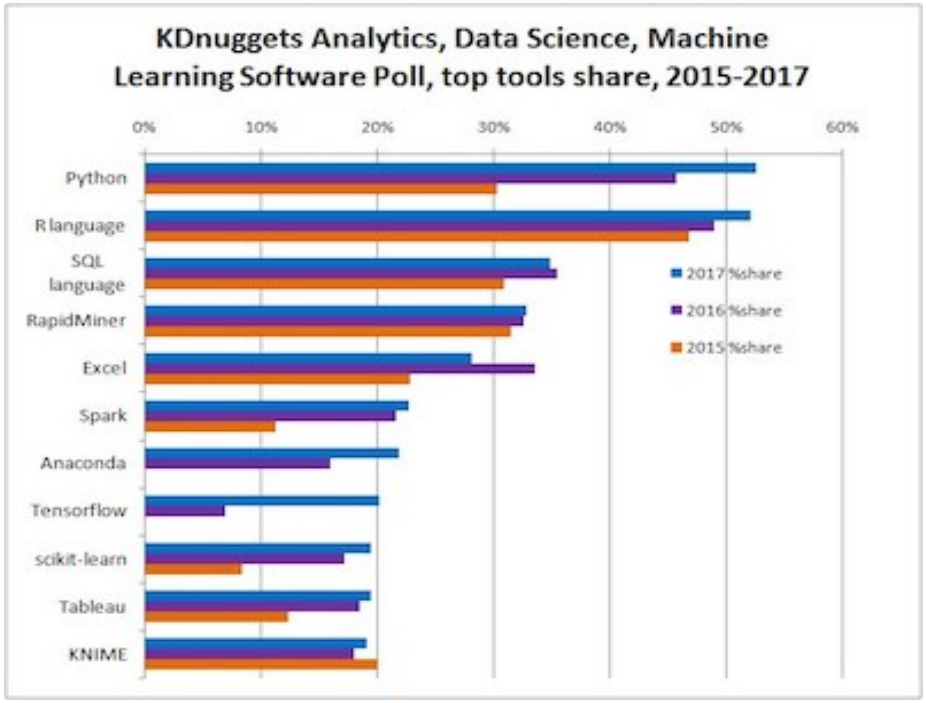
Programma

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

Link naar alle docs:

Intro R

R - software



- 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 !!

Characteristics R

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- **Created in:** 1995 by **R**oss Ihaka & **R**obert 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
- **Numorous Output options**

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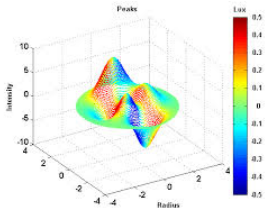

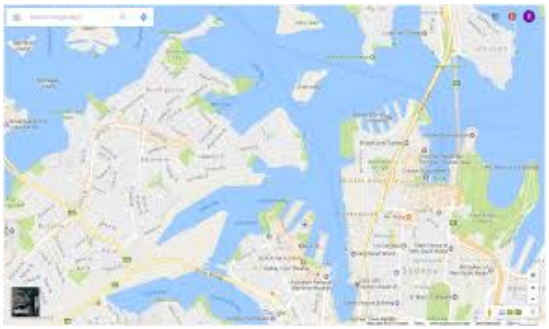

Who can read this?

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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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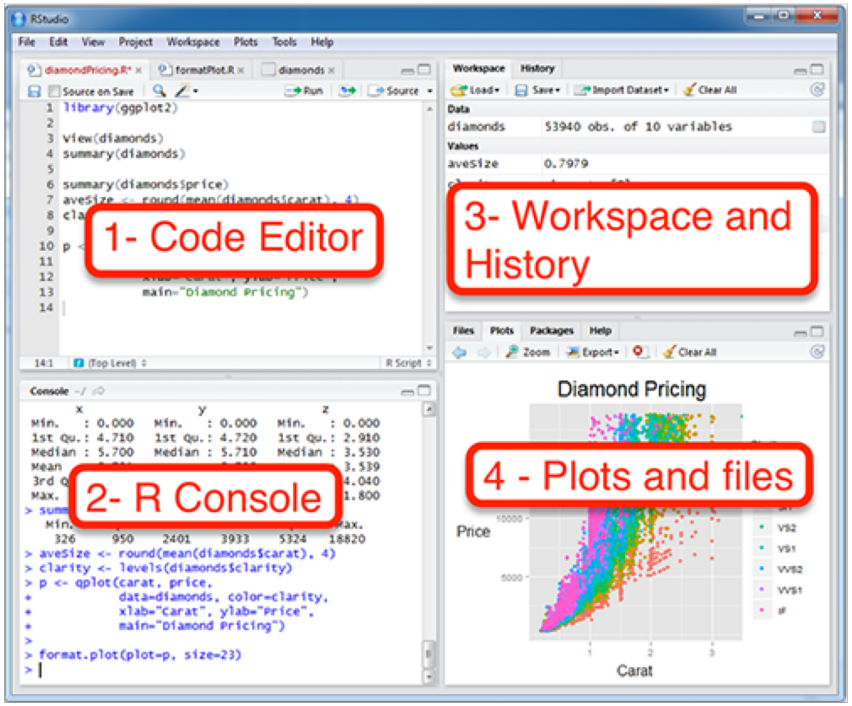
Analysing with R

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



Examplary Packages

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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**

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

Examplary output

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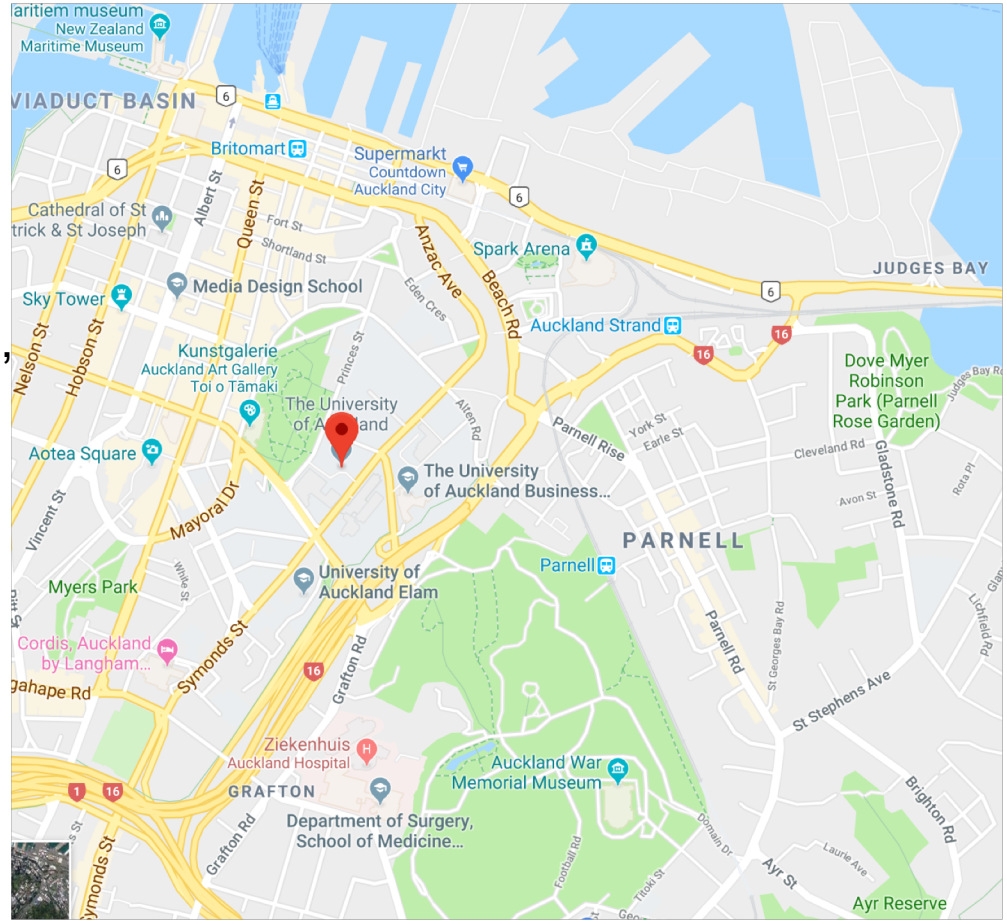
Copy paste command in R

```
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
```



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Amending commands

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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
```

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

Examplary output

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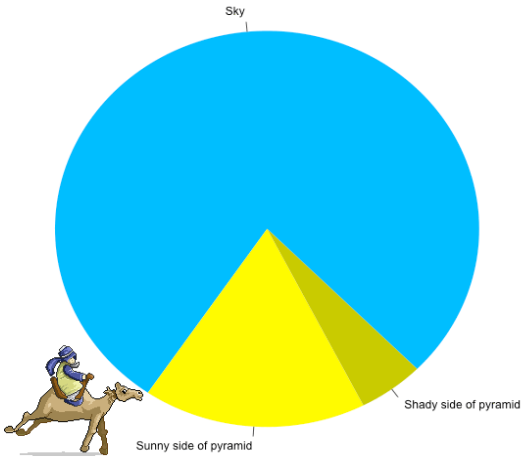
Copy paste command in R

```
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

Practicum

Go to: witusj.github.io/WorkshopSI/

Perform the following exercises:

- Voorbereiding
- Basis R

Remaining exercises can be performed at home

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/WorkshopSl/

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

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Confirmatory Factor Analysis (Dutch)

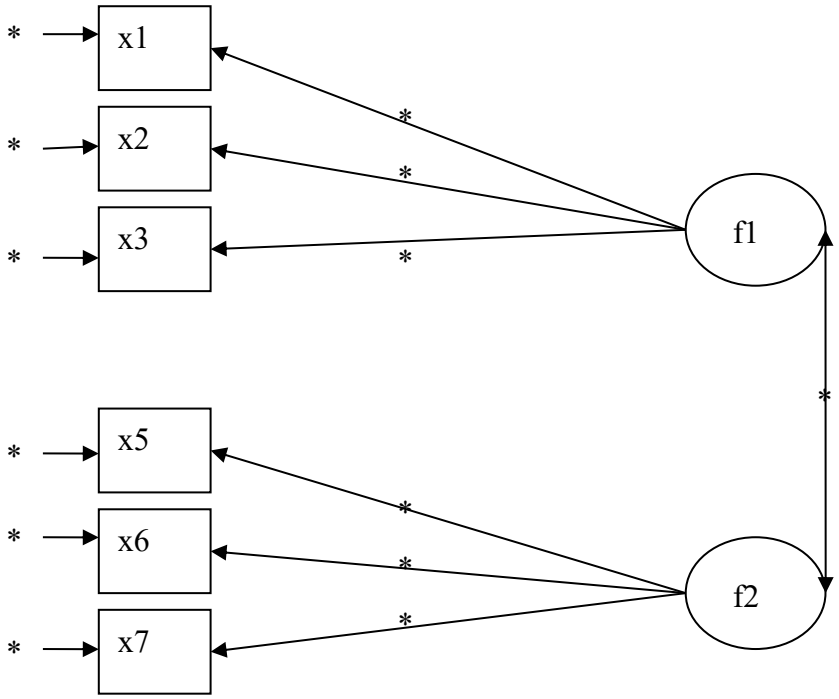
CFA

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

CFA model:

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

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,

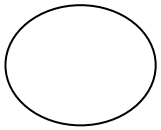
…

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

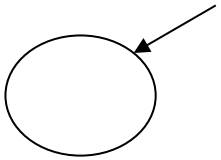
Notatie voor tekenen van modellen

Een manifeste variabele

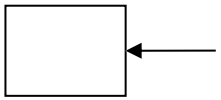


Een latente variabele

Een causale relatie



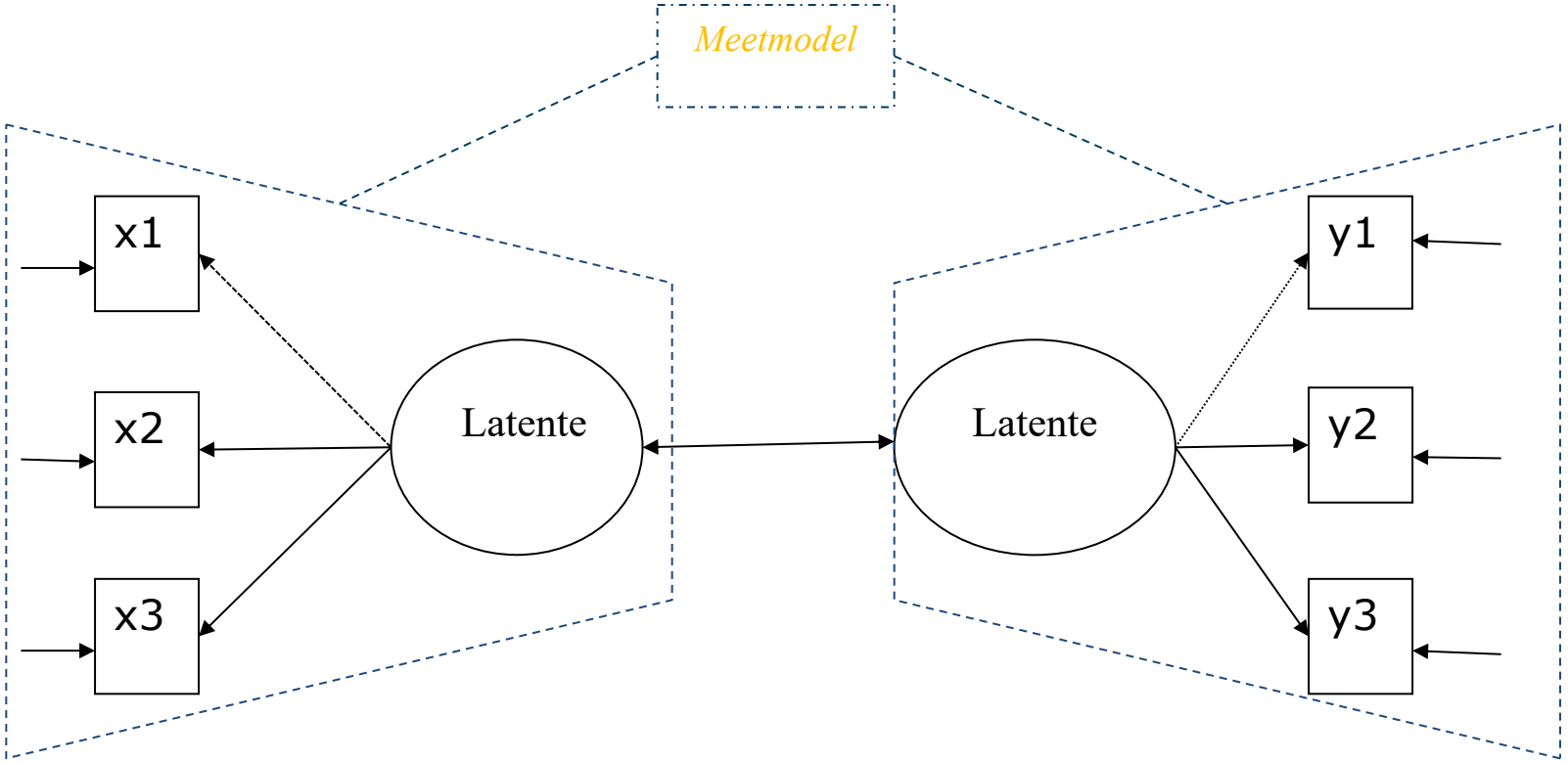
Meetfouten bij latente variabelen



Meetfouten bij manifeste variabelen

Correlatie/ covariantie tussen variabelen

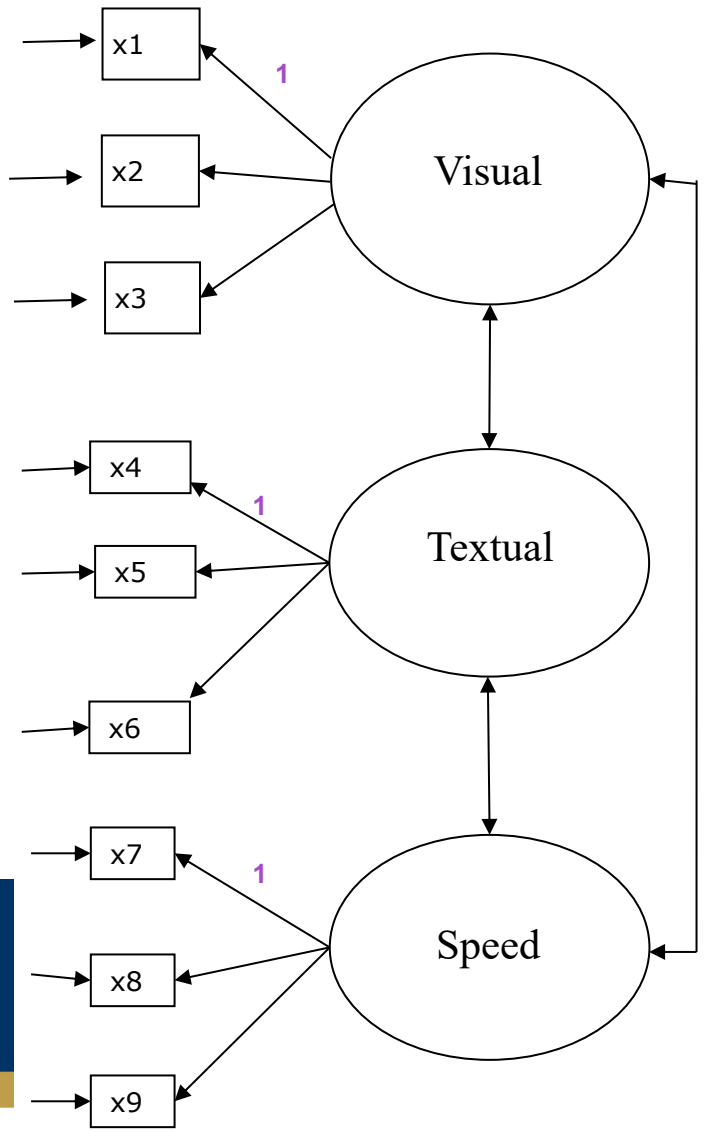
Voorbeeld model CFA



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:

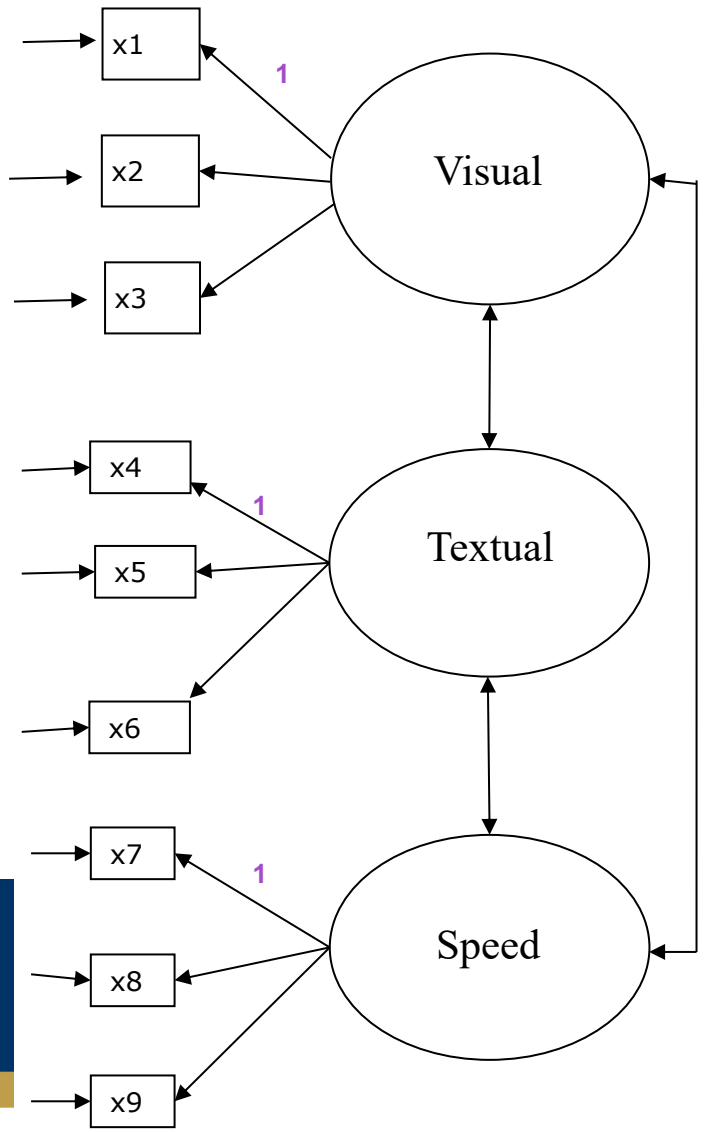
```
fitMeasures(fitM1, c("cfi.scaled", "rmsea", "gfi",
"agfi", "nnfi", "chisq", "chisq.scaled",
"df.sclaled") )
```

Voor de modificatie indeces:

```
modindices(fitM1)
```

Rood = aanpassen aan eigen variabelen/items/namen

Voorbeeld met LAVAAN in R



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fit1<- cfa (...., data = …….)

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]

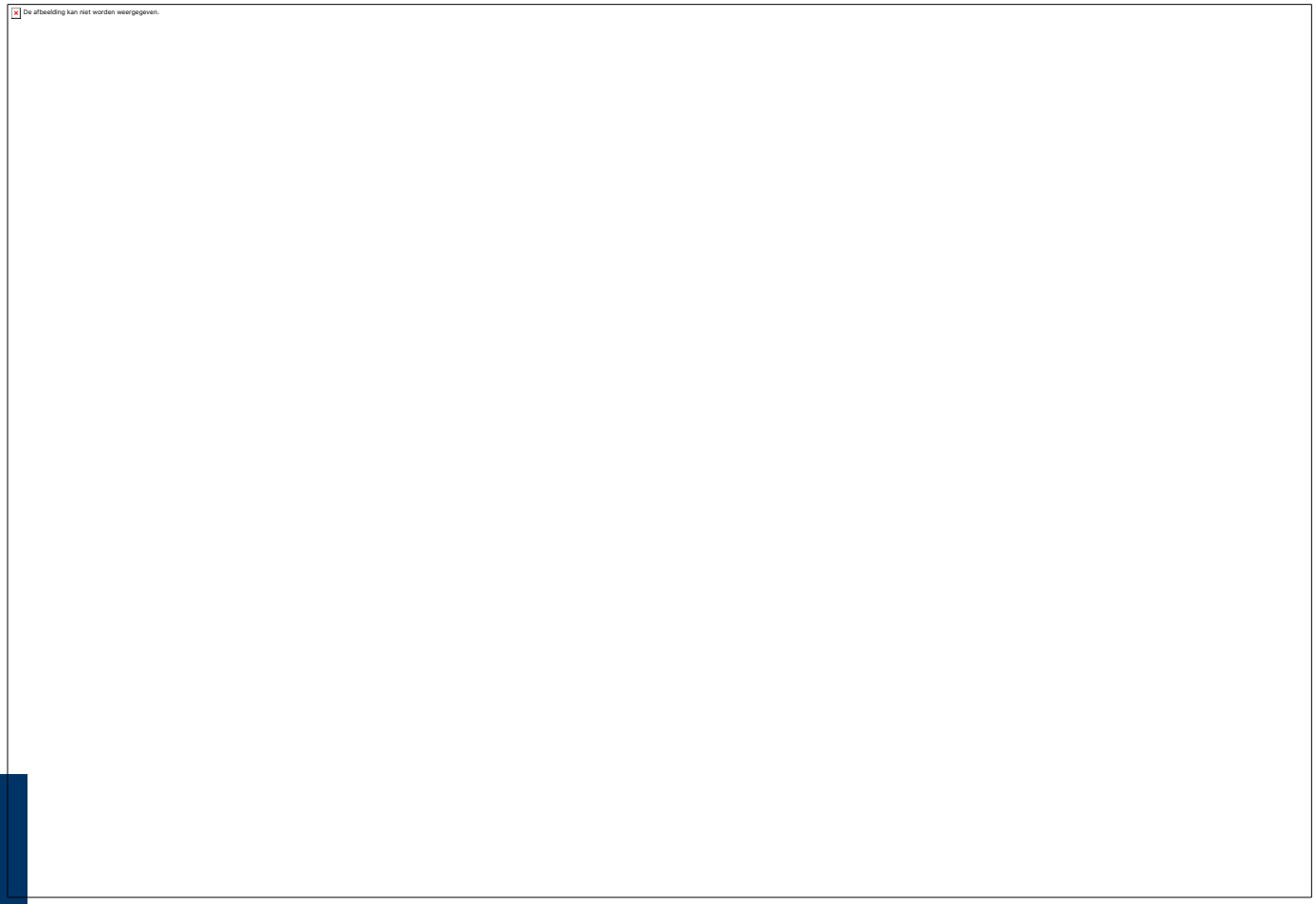
a = Ullman(2001). b = Hu & Bentler (1999). c = Schumacker & Lomax (2004). d = Byrne (1994)

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



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?