Confirmatory Factor Analysis (CFA)

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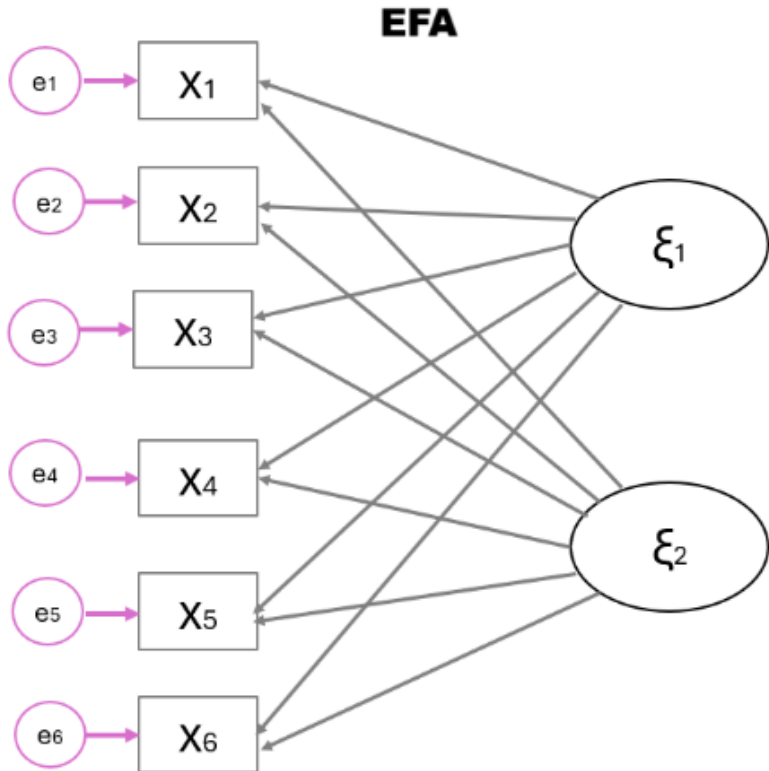
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Exploratory Vs Confirmatory Factor Analysis

Exploratory Factor Analysis (EFA) focuses on **identifying common factors** that explain the correlations among observed variables, with the aim of uncovering the data's **underlying structure**.

Confirmatory factor analysis (CFA) can be used to study **how well a hypothesized factor model fits a new sample** from the same population or a sample from a different population.

Vs
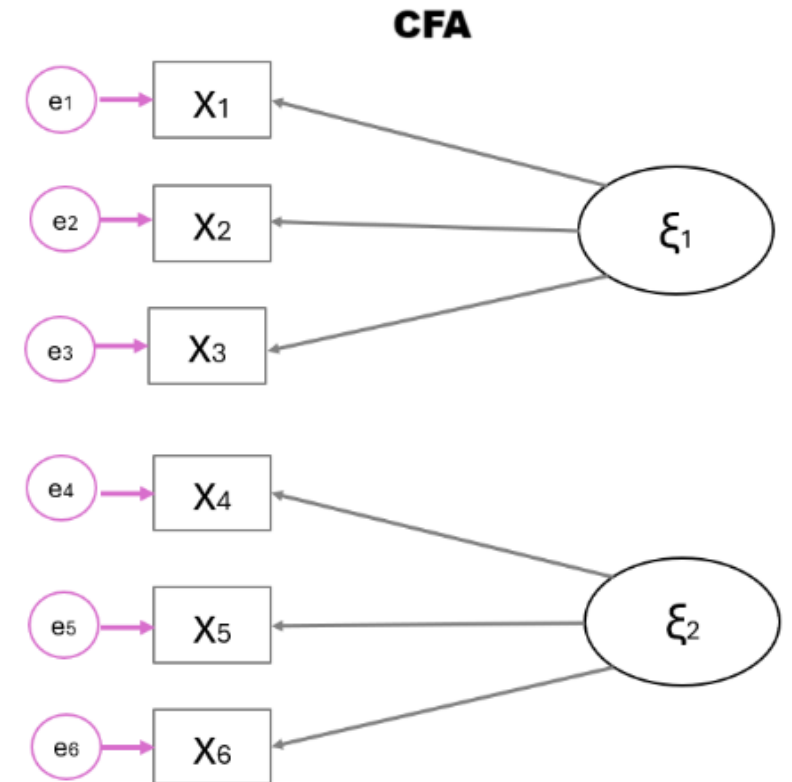
Measure of Fit in CFA

- ## Chi-square test

H$_0$: The model fits the data perfectly

- ## Approximate Fit Index

Incremental
CFI, TLI

Absolute
RMSEA, SRMR

Criteria

Standardized Estimates significant, strong

Non-significant chi-square

$CFI \geq 0.95$

$RMSEA \leq 0.05$ (but definitely < 0.10)

$SRMR \leq 0.08$ (but definitely < 0.10)

Combination rule:
$CFI \geq 0.95$ and
$SRMR \leq 0.08$

Example

**Gendered Racial Microaggressions Scale for Asian American Women**

- 22 items (observed variables or indicators) rated on a 6-point Likert scale ranging from 0 (not at all stressful) to 5 (extremely stressful).

- 4 subscales (factors or latent variables)
  - Ascribed Submissiveness (9 items)
  - Asian Fetishism (4 items)
  - Media Invalidation (5 items)
  - Assumptions of Universal Appearance (4 items)

Example

- Ascribed Submissiveness (9 items)
  - Others expect me to be submissive. (AS1)
  - Others have been surprised when I disagree with them. (AS2)
  - Others take my silence as a sign of compliance. (AS3)
  - Others have been surprised when I do things independent of my family. (AS4)
  - Others have implied that AAW seem content for being a subordinate. (AS5)
  - Others treat me as if I will always comply with their requests. (AS6)
  - Others expect me to sacrifice my own needs to take care of others (e.g., family, partner) because I am an AAW. (AS7)
  - Others have hinted that AAW are not assertive enough to be leaders. (AS8)
  - Others have hinted that AAW seem to have no desire for leadership. (AS9)
- Asian Fetishism (4 items)
  - Others express sexual interest in me because of my Asian appearance. (AF1)
  - Others take sexual interest in AAW to fulfill their fantasy. (AF2)
  - Others take romantic interest in AAW just because they never had sex with an AAW before. (AF3)
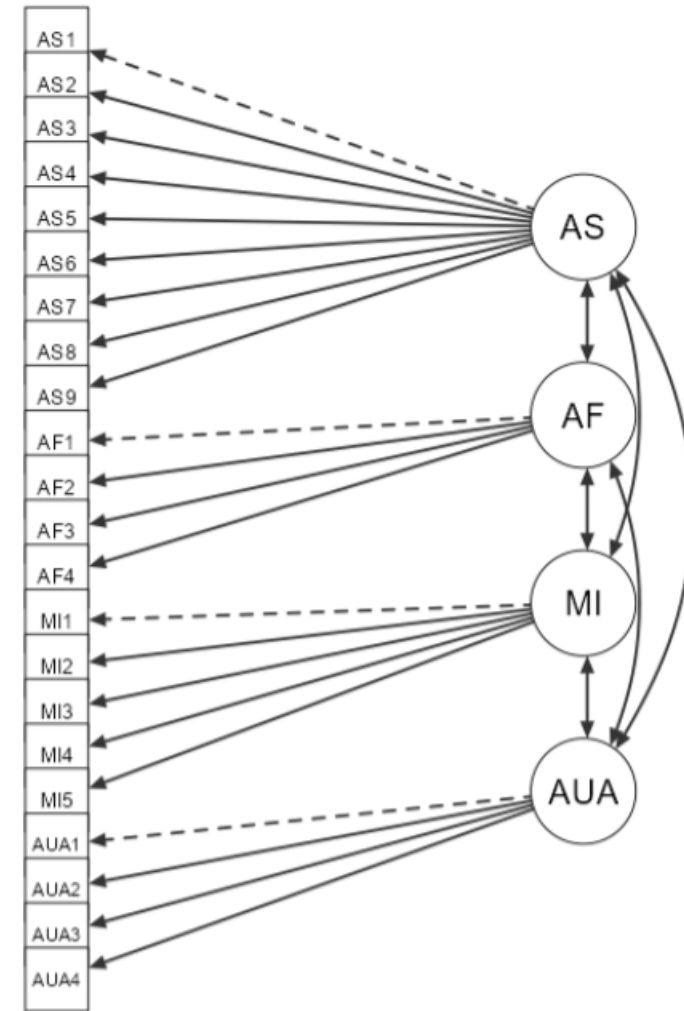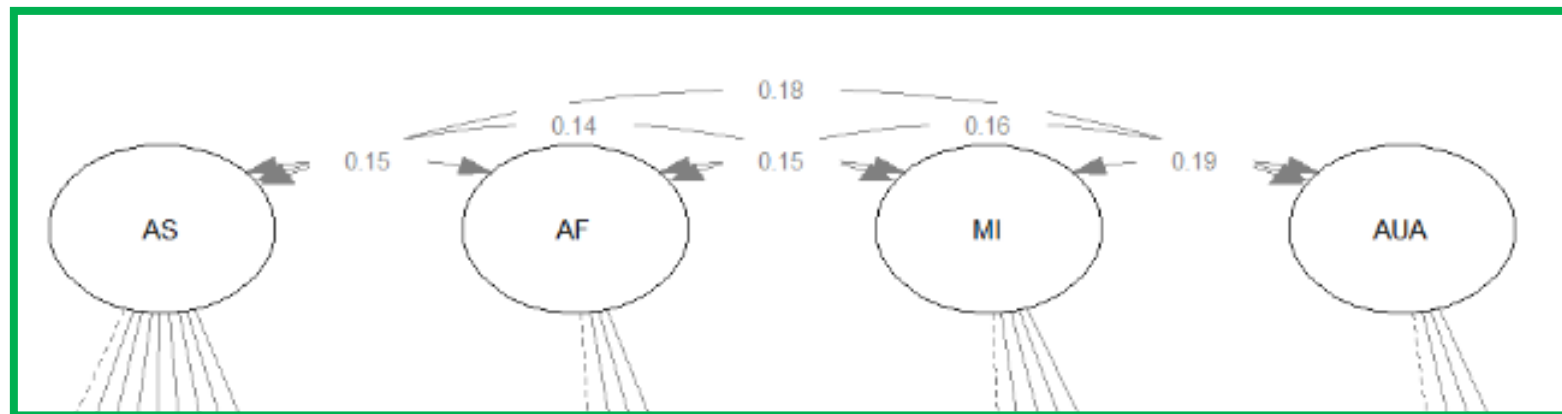
The equations of the model
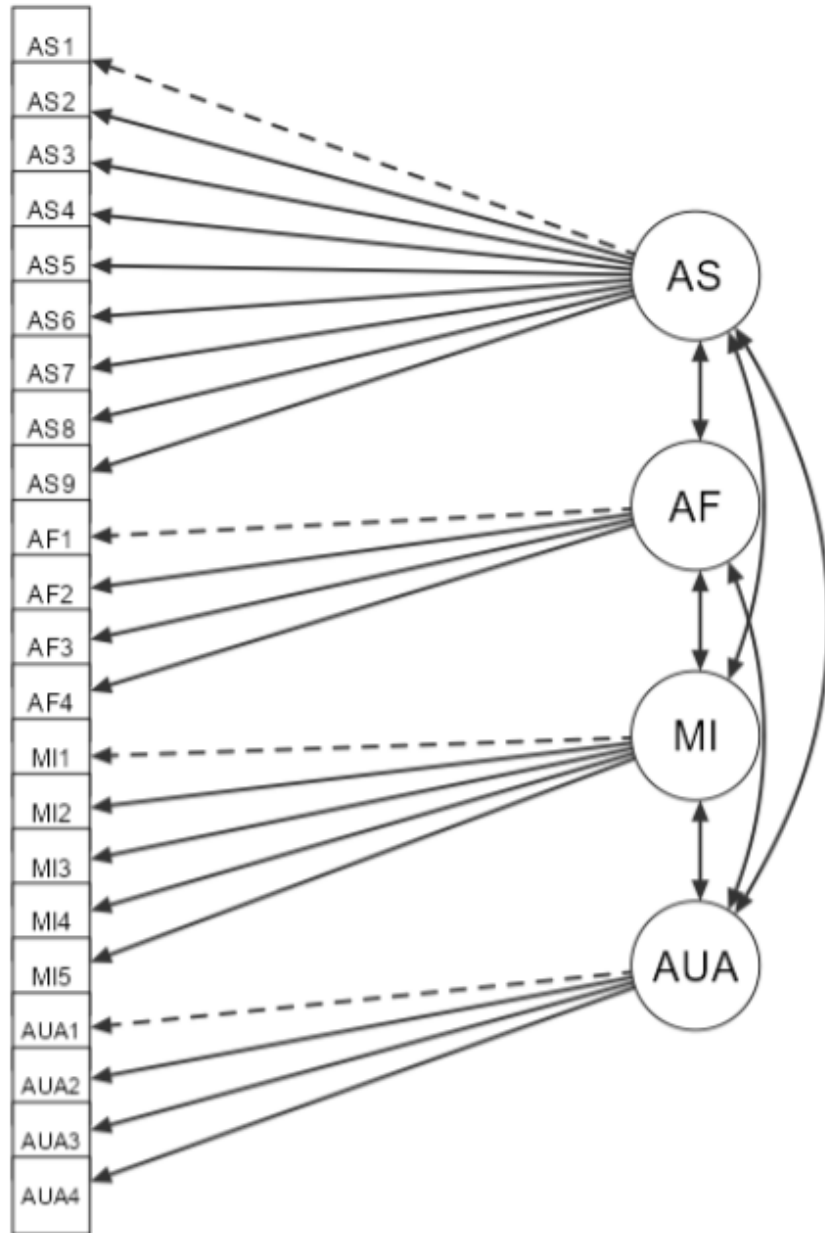
$$AS_1 = intercept1 + l_1 \cdot AS + e_1$$

$$AS_2 = intercept2 + l_2 \cdot AS + e_2$$

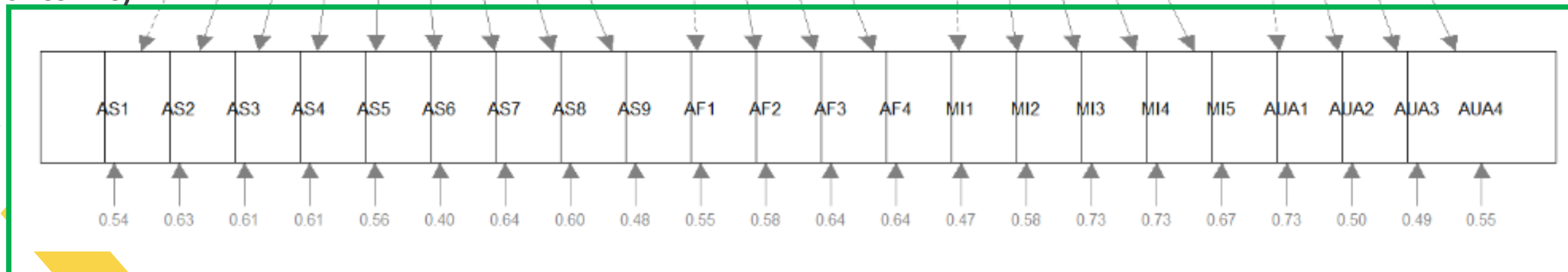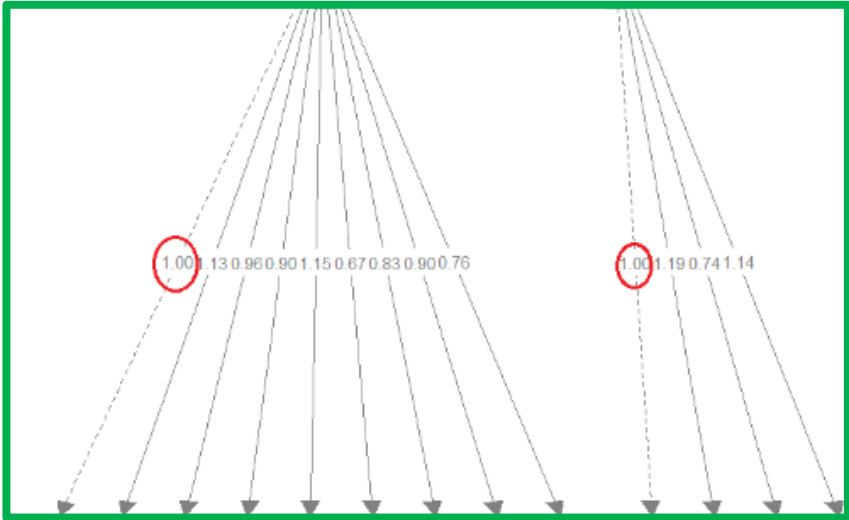$$AS_3 = intercept3 + l_3 \cdot AS + e_3$$

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Factor Loadings (regression coefficients) table

Factor Loadings

Factor	Indicator	Estimate	SE	95% Confidence Interval		Z	p	Stand. Estimate
				Lower	Upper			
AS	AS1	1.000 ᵃ						0.600
	AS2	1.132	0.136	0.865	1.398	8.315	< .001	0.617
	AS3	0.958	0.124	0.716	1.200	7.747	< .001	0.561
	AS4	0.901	0.120	0.666	1.137	7.502	< .001	0.536
	AS5	1.152	0.131	0.894	1.409	8.768	< .001	0.647
	AS6	0.669	0.095	0.484	0.855	7.083	< .001	0.503
	AS7	0.829	0.120	0.594	1.063	6.932	< .001	0.495
	AS8	0.905	0.122	0.666	1.143	7.432	< .001	0.540
	AS9	0.757	0.104	0.553	0.961	7.258	< .001	0.514
AF	AF1	1.000 ᵃ						0.563
	AF2	1.195	0.181	0.840	1.550	6.598	< .001	0.621
	AF3	0.738	0.132	0.479	0.997	5.591	< .001	0.422
	AF4	1.138	0.169	0.807	1.468	6.744	< .001	0.584
MI	MI1	1.000 ᵃ						0.577
	MI2	0.917	0.153	0.618	1.216	6.003	< .001	0.501
	MI3	1.169	0.182	0.812	1.526	6.413	< .001	0.550

Factor Variances and Covariances

Factor Covariances

		Estimate	SE	95% Confidence Interval Lower	95% Confidence Interval Upper	Z	p	Stand. Estimate
AS	AS	0.30	0.06	0.19	0.42	5.25	< .001	1.00
	AF	0.15	0.03	0.09	0.21	5.03	< .001	0.53
	MI	0.14	0.03	0.08	0.19	4.90	< .001	0.51
	AUA	0.18	0.03	0.11	0.25	5.34	< .001	0.60
AF	AF	0.26	0.06	0.14	0.37	4.32	< .001	1.00
	MI	0.15	0.03	0.09	0.22	4.89	< .001	0.63
	AUA	0.16	0.03	0.10	0.23	5.00	< .001	0.59
MI	MI	0.23	0.05	0.13	0.33	4.53	< .001	1.00
	AUA	0.19	0.04	0.12	0.26	5.14	< .001	0.71
AUA	AUA	0.31	0.07	0.17	0.44	4.34	< .001	1.00

Residuals covariances (error terms)
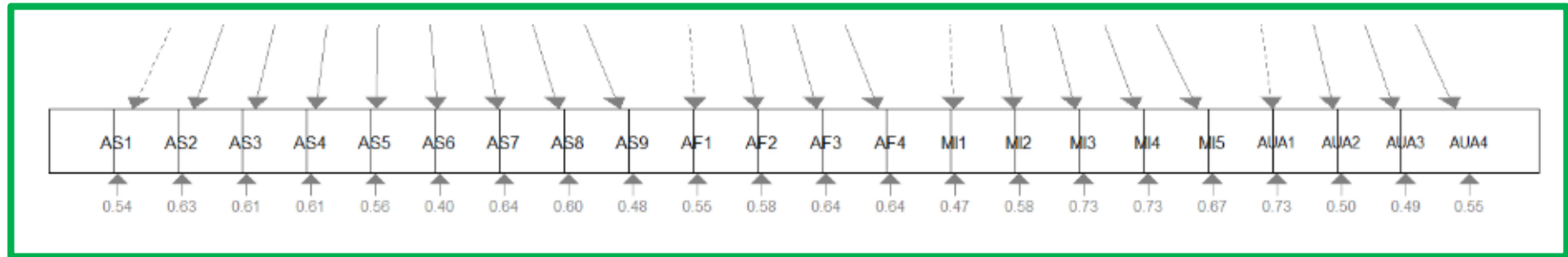
Residual Covariances

		Estimate	SE	95% Confidence Interval		Z	p	Stand. Estimate
				Lower	Upper			
AS1	AS1	0.54	0.05	0.44	0.64	10.80	< .001	0.64
AS2	AS2	0.63	0.06	0.52	0.75	10.65	< .001	0.62
AS3	AS3	0.61	0.05	0.50	0.71	11.08	< .001	0.69
AS4	AS4	0.61	0.05	0.50	0.72	11.24	< .001	0.71
AS5	AS5	0.56	0.05	0.45	0.66	10.36	< .001	0.58
AS6	AS6	0.40	0.04	0.33	0.47	11.41	< .001	0.75
AS7	AS7	0.64	0.06	0.53	0.75	11.45	< .001	0.76
AS8	AS8	0.60	0.05	0.50	0.71	11.22	< .001	0.71
AS9	AS9	0.48	0.04	0.40	0.57	11.37	< .001	0.74