

Internal structure evidence of validity

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Outlines

1. Measurement validity & reliability
2. Classical validity
3. The validity
4. Factor analysis
5. Reliability

1. Measurement validity & Reliability

- Measurement → Process of observing & recording.
- Measurement validity → Accuracy.
- Measurement reliability → Precision, consistency, repeatability.

2. Classical validity

- 3Cs:
 1. Content
 2. Criterion
 3. Construct

3. The validity

- Unitary concept.
- Degree of evidence → Purpose & Intended use of a tool.
- Evidence from 5 sources:
 1. Content.
 - 2. Internal structure.**
 3. Relations to other variables
 4. Response process.
 5. Consequences.

The validity

- Construct – Concept to be measured by a tool.
- *Construct = Concept = Domain = Idea*
- Internal structure evidence
 - How relationship between items & components reflect construct.
 - Analyses:
 1. Factor analysis
 2. Reliability

4. Factor Analysis

- Factoring
- Factor analysis

Factoring

- Group things that have common concept.
- Simplify.
- Factoring = Grouping = Simplify
- Factor → Construct

Intuitive factoring

Orange, motorcycle, bus,
durian, banana, car

Anything in common?

Intuitive factoring

- Group them

Orange, durian, banana

Motorcycle, bus, car

into 2 groups

Intuitive factoring

- Name the groups

Fruit

Motor vehicle

Orange
Durian
Banana

Motorcycle
Bus
Car

factor out the common concept.

Intuitive factoring

Likert scale [Fruit] 1-2-3-4-5 [Motor Vehicle] →
correlation matrix

Items	1	2	3	4	5	6
1. Orange	1.00					
2. Durian	.67	1.00				
3. Banana	.70	.81	1.00			
4. Motorcycle	.11	.08	.05	1.00		
5. Bus	.08	.12	.09	.75	1.00	
6. Car	.18	.12	.22	.89	.83	1.00

Intuitive Factoring

Factors

Items	Fruit	Motor vehicle
1. Orange	X	-
2. Durian	X	-
3. Banana	X	-
4. Motorcycle	-	X
5. Bus	-	X
6. Car	-	X

Correlated items → Group.
More items? Impossible.
FA → **objective factoring**.

FA

- Multivariate analysis – >1 outcomes/DVs/Items.
- Numerical items, e.g. Likert scale, VAS scores, laboratory results etc.
- Cluster correlated items → Factor.
- Factors extracted from items → Latent (unobserved) IVs.
- RQs:
 - Number of factors?
 - Strength of Item-Factor correlation (factor loading)?
- Recall – MLR: 1 DV many IVs (observed).

Classification

1. **Exploratory FA/EFA**
2. Confirmatory FA/CFA

EFA

- Exploratory analysis.
- Objectives: Explore & factor items, generate theory.
- Models:
 - **Full component model.**
 - **Common factor model.**

EFA

- **Full component model**

- Extraction method: Principal component analysis (PCA)
- Data reduction → For other analysis.
- All variances → Components.
- Error NOT considered.
- NOT the real FA!

EFA

- **Common factor model**

- Extraction methods:

- Classical: **Principal axis analysis.**
- Other variants: Image analysis, alpha analysis, maximum likelihood (ML).

- Common + Error variances.

- The 'Real' FA.

- Main results:

- Number of factors extracted.
- Factor loadings.
- Factor-factor correlations.

EFA

- To further simplify EFA results → Factor Rotation:
 - Types:
 - **Orthogonal method** – uncorrelated factors.
 - Varimax, Quartimax, Equamax
 - **Oblique method** – correlated factors.
 - Promax, *Direct Oblimin*
 - Obtain clear factors & factor loadings.

Classification

1. Exploratory FA/EFA
2. **Confirmatory FA/CFA**

CFA

- Confirmatory analysis.
- Common factor model.
- Structural Equation Modeling (SEM) analysis:
 - Measurement model (CFA)
 - Structural model (path analysis)
- Commonly ML estimation.
- Model fit assessment.

CFA

- For example, correlation between these items:

I love fast food

I hate vegetable

I hate eating fruits

I hate exercise

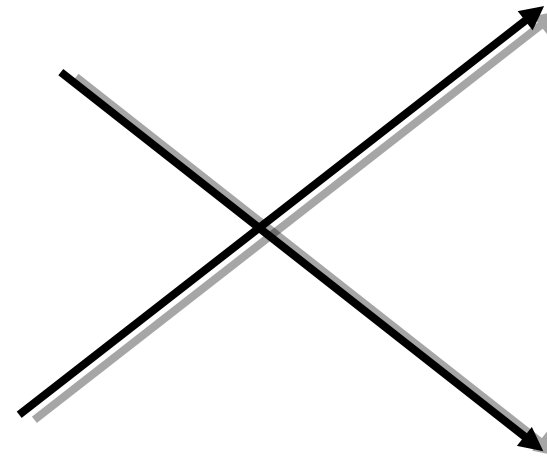


Obesity

Strong theoretical basis from EFA, theory, LR.

CFA

- I love cat
- I hate snake
- I love travelling
- I love snorkeling
- I support ABC football team
- I love driving car
- I love computer game
- I like to have everything normally distributed
- I am a strong believer of central limit theorem
- My favourite food is nasi ayam
- I enjoy eating pisang goreng
- I spend most of my time in front of computer
- I love R



?

?



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Correlation between items? No idea → EFA

EFA vs CFA

EFA

CFA

Exploratory

Confirmatory

No need theory

Theory

Explore to get theory

Confirm theory

Item not fixed to factor

Item fixed to factor

Rotation

No rotation

No Hx testing

Hx testing & model fit

5. Reliability

- Part of validity evidence.
- Types:
 1. Test-retest reliability
 2. Parallel-forms reliability
 3. Interrater reliability
 4. **Internal consistency reliability**

Internal consistency reliability

- Consistent responses in a construct.
- Homogenous → ↑ Reliability.
- Heterogenous → ↓ Reliability.
- Advantage: Measure 1x only.
- **EFA: Cronbach's alpha coefficient.**
- **CFA: Raykov's rho**
- Not reliable 0 → 1 Perfectly reliable.
- Aim > 0.7.



Thank You