

# Investigating Measurement Invariance in PISA 2012

Measures of Self Efficacy and Performance in Mathematics

CSSM502

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# Measurement Invariance

- "invariant": The construct has the same meaning or the structure for different groups <sup>(1)</sup>.
- invariance = equivalence
- When a construct is not invariant, the groups that have same true score for that construct can have different observed scores.
- It is crucial to obtain for the group-level analyses.

(1) Putnick, D. L., & Bornstein, M. H. (2016). Measurement invariance conventions and reporting: The State of the art and Future Directions for Psychological Research. *Developmental Review*, 41, 71–90.  
<https://doi.org/10.1016/j.dr.2016.06.004>

# Data & Measures

- PISA: Testing of 15-year-old students for their ability and attitude in science, reading, and mathematics<sup>(2)</sup>.
  - Large scale testing
    - Participants from +60 countries.
  - Developed for group-level analyses for the countries.
  - 2012 → N = 480178
- The countries (chosen among 65):
  - Turkey (n = 4848)
  - The Netherlands (n = 4460)
- Measures of interest:
  - Math Self Efficacy (8-item scale)
  - Math Performance (5 scaled scores, calculated based on IRT)

# Data Analysis

- Data Preparation
  - with Python
  - Final sample sizes (after excluding missing data):
    - For Turkey →  $n = 3130$
    - For The Netherlands →  $n = 2779$
- Multigroup Confirmatory Factor Analysis (MGCFA)
  - with R
  - It has 3 steps:
    1. Configural Invariance
    2. Metric Invariance
    3. Scalar Invariance

# MGCFA Results: Math Self Efficacy

## Cutoffs for general:

CFI > 0.90

RMSEA < 0.08

## Cutoffs for “metric”:

$\Delta$ CFI < 0.02

$\Delta$ RMSEA < 0.03

## Cutoffs for “scalar”:

$\Delta$ CFI < 0.01

$\Delta$ RMSEA < 0.01 <sup>(1)</sup>

Math Self Efficacy	X <sup>2</sup>	df	p	X <sup>2</sup> / df	SRMR	TLI	CFI	RMSEA	$\Delta$ CFI	$\Delta$ RMSEA
Configural Invariance	598.165	38	<.0001	15.74	0.03	0.947	0.964	0.071		
Metric Invariance	656.277	45	<.0001	14.58	0.037	0.951	0.961	0.068	0.003	0.003
Scalar Invariance	1119.781	52	<.0001	21.53	0.051	0.927	0.932	0.083	0.029	-0.015

Weak measurement invariance

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# MGCFA Results: Math Performance

## Cutoffs for general:

CFI > 0.90

RMSEA < 0.80

## Cutoffs for “metric”:

$\Delta$ CFI < 0.02

$\Delta$ RMSEA < 0.03

## Cutoffs for “scalar”:

$\Delta$ CFI < 0.01

$\Delta$ RMSEA < 0.01 <sup>(1)</sup>

Math Performance	$\chi^2$	df	p	$\chi^2 / df$	SRMR	TLI	CFI	RMSEA	$\Delta$ CFI	$\Delta$ RMSEA
Configural Invariance	10.125	10	0.43	1.01	0.001	1.00	1.00	0.002		
Metric Invariance	12.556	14	0.56	0.90	0.003	1.00	1.00	<0.0001	0	0.002
Scalar Invariance	16.519	18	0.56	0.92	0.004	1.00	1.00	<0.0001	0	0

“Questionable” perfect results

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Thank you!