



University of  
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# Multidimensionality Continued

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# Multidimensionality

The Rasch model assumes that a questionnaire measures only one single latent trait or construct.

In presence of multidimensionality, the scale measures different aspects of a construct and single interval scaled sum score is not meaningful anymore.

# Multidimensional Rasch Analysis

- Rasch model accommodates various assessment situations where the data is unidimensional.
- In the 1990's, Multidimensional Random Coefficient Multinomial Logit (MRCML) or multidimensional Rasch model.
- Free software only after 2010, with the R-packages mirt and TAM.

# Multidimensional Rasch Analysis

The MRCML can be written as a PCM with Q dimensions:

$$P(X_{ikn} = k | \theta_{nq}) = \frac{\exp(\theta_{nq} - \delta_{ik})}{\sum_{c=0}^{m_i} \exp(\sum_{h=0}^c (\theta_{nq} - \delta_{ih}))}$$

Two types of MRCML accounting for:

**Between-item multidimensionality:** each item only in one dimension

**Within-item multidimensionality:** items can belong to more than one dimension

# Assessing Dimensionality

The PCA is an **explorative approach** to find out if a scale is unidimensional or multidimensional.

The MRCML can be used for hypothesis driven dimensionality testing, i.e. **confirmative approach**.

**Goal:** find a conceptualization of the scale with smallest number of significantly contributing dimensions (ex. theory or statistically driven).

The change in the quality of the fit of nested multidimensional models can be tested for significance with a Likelihood Ratio Test.

# Estimation Algorithms

## **CML Conditional Maximum Likelihood:**

Bases only on the data, specifically on the row score (sufficient statistic)

Found in package eRm. For unidimensional models

## **MML Marginal Maximum Likelihood:**

Assumes a distribution of the person parameter (typically normal)

Found in package mirt and TAM. For multidimensional and Irt models

## Let's go to R-Studio

Open the R-Script MS9\_Rscript.r that you can find, in the OLAT or the MS-Teams Course Materials.

## Exercise:

**Challenge** : Find a better fitting 3 dimensional model using the MDS-data.