Homework assignment
L7: IRT models for binary data

Assignment date:	**20.11.2018**
Deadline:	**26.11.2018 23:59**
Slides:	http://www.cs.cas.cz/martinkova/NMST570
Note:	Send answers and `R` script to drabinova@cs.cas.cz
Name:	

1 Reading

Read chapter 2 "Unidimensional logistic response models" of Handbook of Item Response Theory, volume 1 and answer following questions.

Ex. 1.1 In sections "Presentation of the Models" and "Parameter Estimation":

1. What are two versions in which logistic response models exist? [0.25]

2. What is the main difference between these two versions? [0.25]

3. What was the favorite method of parameter estimation in Rasch model? [0.25]

4. What was the typical method of parameter estimation in 2PL and 3PL model? [0.25]

5. What is the standard procedure in estimation of 3PL method and who introduced it? [0.25]

6. What assumption can be ignored with this procedure? [0.25]

7. What is the most frequently used estimation method nowadays in logistic models? [0.25]

Ex. 1.2 In section "Model Identifiability":

1. Briefly describe problem of lack of model or parameter identifiability. [0.5]

2. Provide two sufficient conditions to make fixed-effect 3PL model identifiable? [0.5]

3. What is the common practice for the random-effect 3PL model to make it identifiable? [0.25]

Ex. 1.3 In section "Model Interpretation":

1. Why is it dangerous to ascribe absolute meaning to apparent features of the IRT models? [0.25]

2. Which three features of the IRT models are invariant across reparameterizations? [0.75]

Ex. 1.4 In section "Empirical Example":

1. How many items and how many observations does described dataset consist of? [0.125]

2. Which model was used for analysis and why? [0.125]

3. Why did some items perform poor item-fit? [0.125]

4. Which item displayed in item map (Figure 2.4) is the most difficult/easiest? [0.125]

2 IRT models in R

In the previous lab session you get to know `epi_escore` data covering Extraversion-Introversion of EPI personality test. Data is available at

http://www.cs.cas.cz/drabinova/documents/epi_escore.csv

Upload data into `R` and answer following questions.

Ex. 2.1 Use function `rasch()` from `ltm` package and function `mirt()` from `mirt` package to fit Rasch model for `epi_escore` data. Print estimated item parameters and compare results. Try to explain differences between estimates. [0.75]

Ex. 2.2 Use function `ltm()` from `ltm` package and function `mirt()` from `mirt` package to fit 2PL model for `epi_escore` data. Print estimated item parameters and compare results. Try to explain differences between estimates. [0.75]

Ex. 2.3 In previous HW we noticed that some items have negative discrimination (specifically items 5, 15, 20, 29, 32, 34, 37, 41, and 51).

1. Reverse these items with `reverse.items()` function. [0.125]
2. Fit 2PL IRT model with `mirt()` function. [0.125]
3. Compare estimated item parameters in original data and in data with reversed items. How did the discrimination change? How did the difficulty change? [0.75]
4. Use function `fscores()` to extract factor scores from 2PL IRT model on original data and on data with reversed items. Compare estimates. Briefly comment. [0.75]
5. Check whether model is unidimensional or there are two dimensions of latent trait. Use `anova()` function and briefly comment. [0.75]
6. Use `itemfit()` function to compute item-fit statistics. Compare results for unidimensional model and model with two dimensions. [0.5]
7. Use EM algorithm and quasi-Monte Carlo EM algorithm to estimate parameters in 2PL IRT model. Compare estimates. What is the default option of algorithm? [0.5]
8. Consider 2 different distributions of the latent trait - Gaussian and distribution using an empirical histogram. Fit 2PL IRT models and draw histograms for estimated factor scores. [0.5]

HINT: For exercises 2.1.-2.3. you can use and modify prepared `R` script to answer questions:

http://www.cs.cas.cz/drabinova/documents/NMST570_HW7.R

3 Provide feedback

Here you can provide feedback on lecture, lab session and/or materials (slides, HW assignment, ShinyItemAnalysis manual) [1pt bonus] :)