

# Homework assignment

## L8: Differential item functioning

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**Assignment date:** 03.12.2019  
**Deadline:** 16.12.2019 23:59  
**Slides:** <http://www.cs.cas.cz/martinkova/NMST570>  
**Note:** Send answers and R script to [hladka@cs.cas.cz](mailto:hladka@cs.cas.cz)  
**Name:**

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## 1 Reading

**Ex. 1.1** Read article available at

<https://doi.org/10.1187/cbe.16-10-0307>

and answer following questions:

1. Which methods were used for the DIF detection? [0.25]
2. What are their strengths and limitations? [0.25]
3. How many items and how many respondents are in the data in Case 1? [0.25]
4. Try to interpret significant gender gap in Case 1. [0.25]
5. How was the data set in Case 2 simulated? [0.25]
6. Which methods identify which items as DIF in Case 2? [0.25]

## 2 ShinyItemAnalysis

Use **ShinyItemAnalysis** (online or locally) and consider GMAT data described in previous paper. With DIF/Fairness tab answer following questions.

**Ex. 2.1** Use delta plot method.

1. Which items are detected as DIF when using fixed threshold? [0.25]
2. Which items are detected as DIF when using threshold based on normal approximation? What is the value of the threshold now? [0.25]

**Ex. 2.2** Use Mantel-Haenszel test.

1. Which items are detected as DIF? [0.25]
2. What are the values of DIF effect sizes for DIF items? [0.125]
3. What is the odds ratio for item 1. Interpret the result. What is the odds ratio considering only respondents with total score 12? [0.75]

4. What is the odds ratio for item 7. Interpret the result. What is the odds ratio considering only respondents with total score 12? [0.75]

**Ex. 2.3** Use logistic regression

1. Which items are detected as functioning differently? [0.25]
2. Which items do favor males and which females? Is there any item performing non-uniform DIF? [0.75]
3. How do the results change when using Benjamini-Hochberg (BH) correction for multiple comparison? [0.125]

**Ex. 2.4** Use Lord's test

1. Which items are detected as functioning differently for 2PL IRT model? [0.25]
2. With 2PL IRT model, how do the results change when using item purification? How many iterations were run until convergence? [0.5]

### 3 Real data analysis

Consider `verbal` data set from `difR` package. Follow selected R code in `ShinyItemAnalysis` and create R script to answer following questions.

HINT: Use `data(verbal, package = "difR")` to upload data.

**Ex. 3.1** Explore data:

1. How many items and how many respondents are in the data? [0.125]
  2. Explain names of items (e.g. what do `S1WantCurse` and `S3DoShout` mean?) [0.125]
- HINT: Explore help for `verbal` dataset.

**Ex. 3.2** Fit Mantel-Haenszel test with `difMH()` using item purification.

1. Which items are detected as functioning differently? [0.5]
  2. Try to explain why some items perform positive effect size `deltaMH` and some items perform negative effect size. Try to interpret. [0.5]
  3. Create table describing purification process. [0.5]
- HINT: Check `difPur` value of the `difMH()` output.

**Ex. 3.3** Fit logistic regression method with `difLogistic()`.

1. Which items are detected as functioning differently? [0.5]
2. Plot characteristic curves for DIF items using function `plot()` and argument `plot = "itemCurve"` [0.5]
3. Check plots with characteristic curves. Which items do favor males (reference) and which favor females (focal)? Is there any item showing non-uniform DIF? [0.5]

**Ex. 3.4** Choose at least four methods for DIF detection offered by `difR` package. Use function `dichoDIF()` and create table displaying which items are detected as DIF by each function. Briefly describe your conclusion - which items are DIF, which items are unfair, and what would be the next step? [1]

### 4 Provide feedback

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