ShinyItemAnalysis for psychometric training and research

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Motivation

In some regions or scientific areas, understanding and use of psychometric concepts may be underdeveloped. Freely available and user friendly software may support dissemination of psychometric methods.

Many R packages cover general psychometric concepts or specific psychometric topics, however, for those new to R it may be hard to overcome the initial burden of R code-based environment.

ShinyItemAnalysis

ShinyItemAnalysis (Martinková et al, 2018) is an R package and an online shiny application for psychometric analysis of educational tests and their items. It was developed with the aim to

- Support teaching of psychometric concepts
- Present psychometric research
- Empower routine analysis of educational tests

ShinyItemAnalysis is available **online** at

https://shiny.cs.cas.cz/ShinyItemAnalysis

It is also possible to install the package from **CRAN**

```
install.packages('ShinyItemAnalysis')
```

or **GitHub** (with `devtools` package)

```
install_github('patriciamar/ShinyItemAnalysis')
```

and run it locally:

```
library(ShinyItemAnalysis)
startShinyItemAnalysis()
```

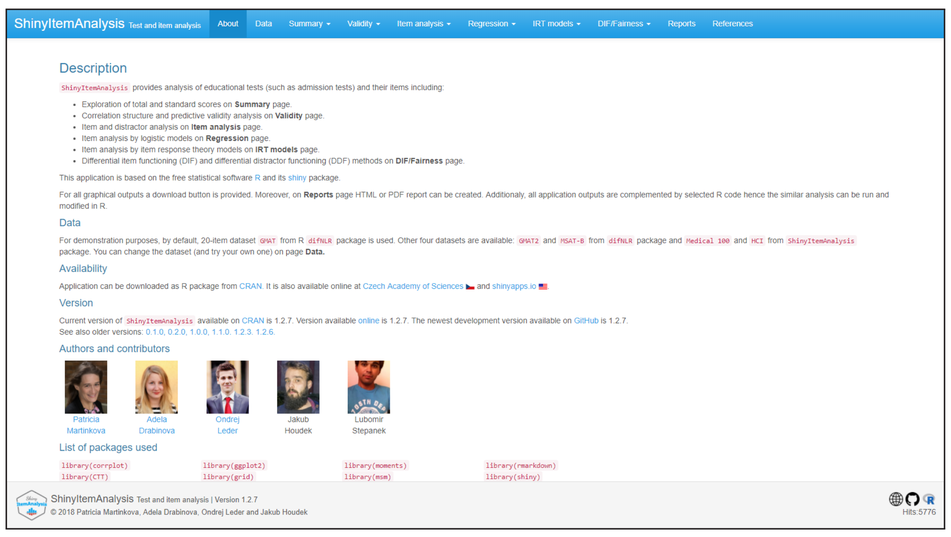
Example use scenarios

- Instructor for introductory measurement class uses the software for an in-class exercise
- A graduate student wants to study IRT independently and uses the program for self-study
- Lecturer checks properties of final exam multiple-choice test using data of their students
- Institution performs quick analysis of their admission tests shortly after administration

Covered topics are organized in sections

- Summary statistics
- Classical Test Theory (CTT), traditional item analysis (reliability, validity, distractor analysis, item difficulty and discrimination)
- Logistic, nonlinear and multinomial models
- Item Response Theory (IRT) models
- Differential Item Functioning (DIF)

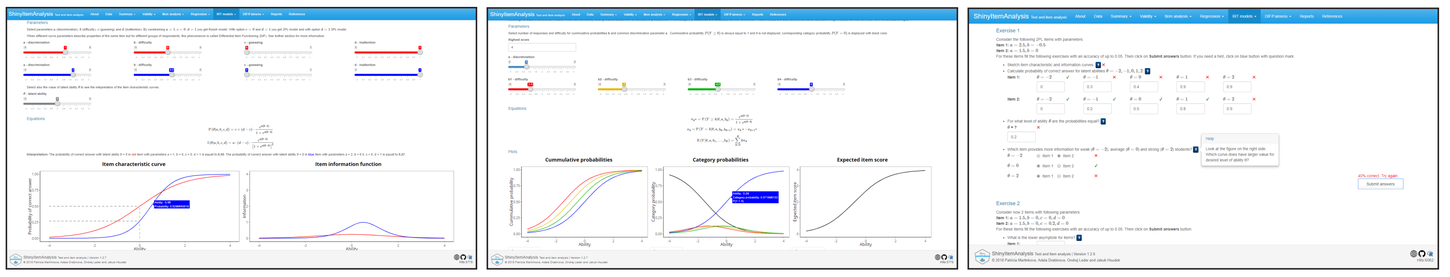
Initial page gives some introductory information.



Teaching psychometrics with ShinyItemAnalysis

ShinyItemAnalysis has some helpful features for teaching:

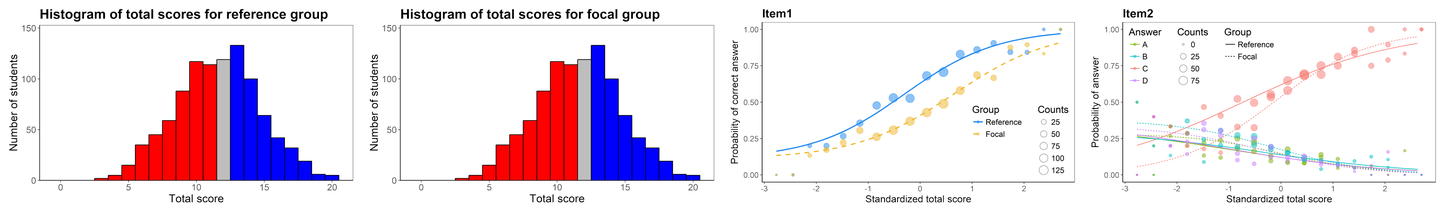
- Broad range of CTT as well as IRT methods, toy data examples
- Model equations, parameter estimates, and interactive interpretation of results
- Selected R code, ready to be copy-pasted and run in R
- Interactive training section including deploying item characteristic and item information curves for selected parameters and automatically graded exercises



Presenting psychometric research

ShinyItemAnalysis is used to present our current results in psychometric research in an interactive way:

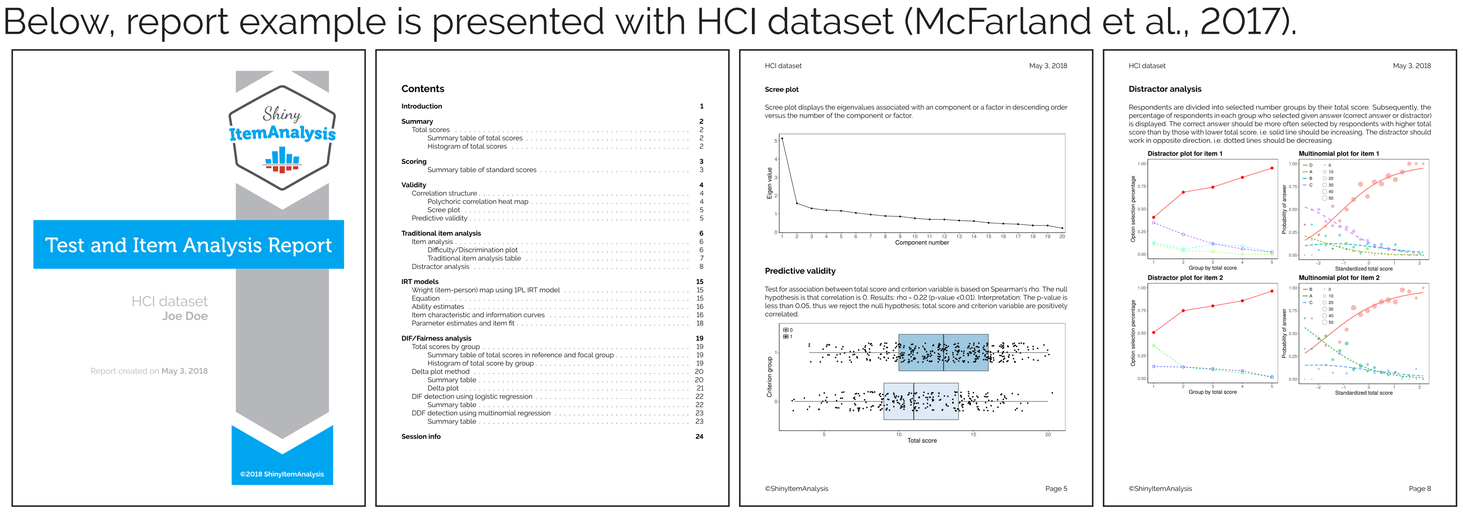
- DIF detection method based on nonlinear regression (Drabinová and Martinková, 2017) is included between offered methods
- Generalized ULI index (Martinková, Štěpánek et al., 2017) is available
- Simulated GMAT dataset is included to demonstrate the theoretical possibility of exactly equal distribution of total scores in groups, while DIF/DDF is still present (Martinková, Drabinová et al., 2017)



Automatic report generation

To support routine usage of psychometric methods in test development, ShinyItemAnalysis offers possibility to upload data for analysis as csv files, and to generate PDF or HTML reports.

Below, report example is presented with HCI dataset (McFarland et al., 2017).



Discussion and conclusion

ShinyItemAnalysis is user-friendly and easily extendable tool for teaching psychometric concepts and for routine psychometric analysis of educational tests.

ShinyItemAnalysis seems to be a promising tool with over

- 6,000 online visits (not accounting for mirror pages)
- 8,000 downloads from CRAN from all over the world.

Use of ShinyItemAnalysis in measurement and psychometric courses allowed for validating functionality of the application. Next planned step is further content validation by higher number of psychometric experts and adding more psychometric methods and references.

ShinyItemAnalysis seems to fulfill its goal to make psychometric methodology available to researchers from various fields and regions.

Please provide your feedback at http://www.ShinyItemAnalysis.org

References

Drabinová, A. and Martinková, P. (2017). Detection of differential item functioning with nonlinear regression: A non-irt approach accounting for guessing. *Journal of Educational Measurement*, 54(4):498–517.
Martinkova, P., Drabinova, A., Leder, O., and Houdek, J. (2018). *ShinyItemAnalysis: Test and item analysis via shiny*. R package version 1.2.7.
Martinková, P., Drabinová, A., Liaw, Y.-L., Sanders, E. A., McFarland, J. L., and Price, R. M. (2017a). Checking equity: Why differential item functioning analysis should be a routine part of developing conceptual assessments. *CBE-Life Sciences Education*, 16(2):rm2.
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McFarland, J. L., Price, R. M., Wenderoth, M. P., Martinková, P., Cliff, W., Michael, J., Modell, H., and Wright, A. (2017). Development and validation of the homeostasis concept inventory. *CBE-Life Sciences Education*, 16(2):ar35.

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