Development of Web-based platform for test analyses based on item response theory

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In this paper, we introduce an integrated system to assist researchers and testing agencies in conducting test data analyses. Our system is an extended version of the system developed by Hiramura, Okubo & Mayekawa (2010), and it not only enables easy analyses of test data and evaluations of respondents but also visually shows useful information. Moreover, an item bank can be maintained, thereby enabling testing agencies to easily perform computer adaptive testing.

Our system also estimates the item parameters of tests containing mixed items and allows assumptions of latent classes and multi-groups in the data structure. Further, as a system feature, a searching capability for item banks as well as a graph drawing function that enables users to report test reliability and validity have been incorporated.

Our system is based on item response theory which is widely used in Psychology and Educational Psychology. In this system, many models can be employed as response models, for example

Graded Response Model (Samejima, 1969)

$$p_{jk}^{(g)}(\theta) = \frac{1}{1+\exp(-\alpha_j^{(g)}(\theta-\beta_{jk}^{(g)}))}$$

Partial Credit Model (Masters, 1982)

$$p_{jk}^{(g)}(\theta) = \frac{\exp(\lambda_j^{(g)}\theta+\zeta_{jk}^{(g)})}{\sum_{k'}^{K_j}\exp(\lambda_j^{(g)}\theta+\zeta_{jk'}^{(g)})}$$

Generalized Partial Credit Model (Muraki, 1992)

$$p_{jk}^{(g)}(\theta) = \frac{\exp(k\lambda_j\theta+\zeta_{jk}^{(g)})}{\sum_{k'=1}^{K_j}\exp(k'\lambda_j^{(g)}\theta+\zeta_{jk'}^{(g)})}$$

Order-constrained Nominal Categories Model (Okubo et al., 2009)

$$p_{jk}^{(g)}(\theta) = \frac{\exp\left(\sum_{l=1}^{k}\alpha_{jl}^{*2(g)}\theta_i+\gamma_{jk}^{(g)}\right)}{\sum_{k'=1}^{K_j}\exp\left(\sum_{l=1}^{k}\alpha_{jl}^{*2(g)}\theta_i+\gamma_{jk'}^{(g)}\right)}$$

Nominal Categories Model (Bock, 1972)

$$p_{jk}^{(g)}(\theta) = \frac{\exp(\lambda_{jk}^{(g)}\theta + \zeta_{jk}^{(g)})}{\sum_{k'}^{K_j} \exp(\lambda_{jk'}^{(g)}\theta + \zeta_{jk'}^{(g)})}$$

Our system is a web application based on the client-server model, and it can be used with web browsers, thereby making it simple to operate. In this development phase, the estimation program has mostly been written in R-language, while C-based programs have been employed in some parts to enable faster calculations. Statistical estimations are performed on a server and are not dependent on the client ' s computer performance. Moreover, our system will be made available on the Internet. In future studies, we aim to develop a test equating function.

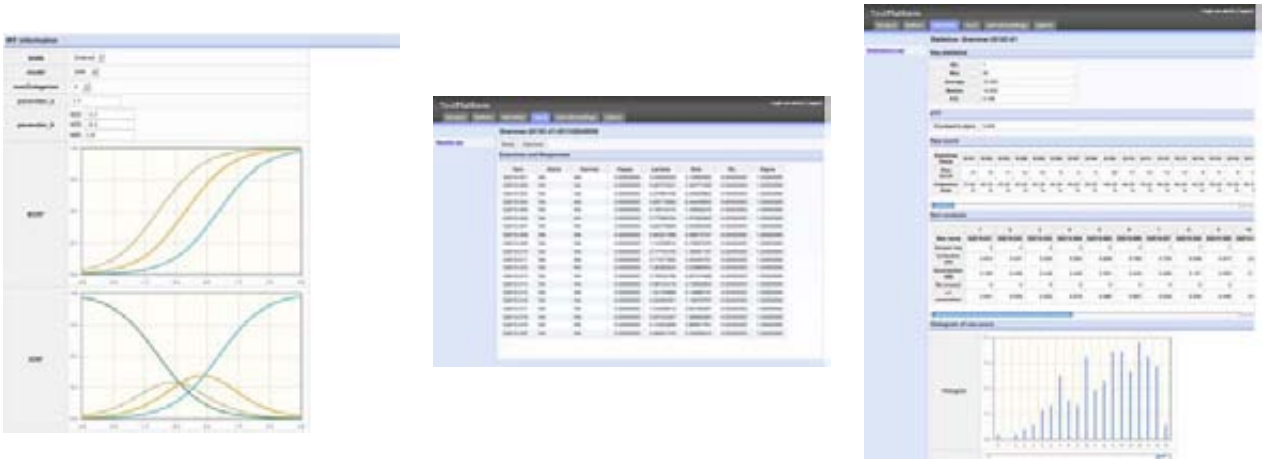

Figure 1: Web-based platform for test analysis

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