A mixture partial credit model for identifying latent classes responsible for differential item functioning

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AIMS :
Ideally, the item response probability to a quality of life (QoL) questionnaire should only depend on the respondents' QoL level. If such a probability also depends on other characteristics such as ethnicity, gender or socioeconomic status, differential item functioning (DIF) may be present. Identifying DIF plays a key role in verifying measurement invariance when validating questionnaires. Moreover, being able to take into account DIF allows limiting measurement biases when analyzing patient-reported ouctomes (PRO) data. Several methodologies have been proposed for dealing with DIF, one of the most flexible and powerful being the IRT-based likelihood ratio test.

With such a method, the covariate suspected to be responsible for DIF on a given item can be identified. For this purpose, nested models (with and without DIF) are compared: one constrained to be DIF-free for the suspected item, and one considering DIF by including interactions between the item parameter and the considered covariate. The best model is then chosen for analyzing data, allowing taking into account DIF if necessary. However, some problems can occur when covariates responsible for DIF are not well identified. Multiple covariates can be wrongly suspected, leading in multiple comparisons thus in type I error rate inflation. Moreover, the covariate truly responsible for DIF might not be identified because it is not a directly observed covariate but a latent variable.

METHODS :
We propose an adaptation of the IRT likelihood ratio test based on mixture partial credit models (PCM). With these models, items parameters are considered as fixed effects and both the latent trait to be analyzed (for example QoL) and the covariate responsible for DIF are considered as continuous and categorical latent variables, respectively. Latent classes can finally be constructed based on such categorical latent variables using individual posterior probabilities, and then described using observed data.

RESULTS :
We illustrate the properties of such likelihood ratio test based on mixture PCM using both simulated data and observed data from the Pays-de-la-Loire Workers Surveillance Program (France), and provide a MPlus based macro-program working under Stata for performing such a procedure.

CONCLUSIONS :
We believe that such program may facilitate the use of these methods by researchers.

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