NATIONAL RESEARCH UNIVERSITY

Measuring Student's Proficiency in MOOCs: Multiple Attempts IRT Extensions

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Accurate proficiency measures are important to…

- Students
- Professors
- Universities

Proficiency is a latent variable…

… hidden from direct observation

We use indicators and rules…

… to link the observable side to the latent side

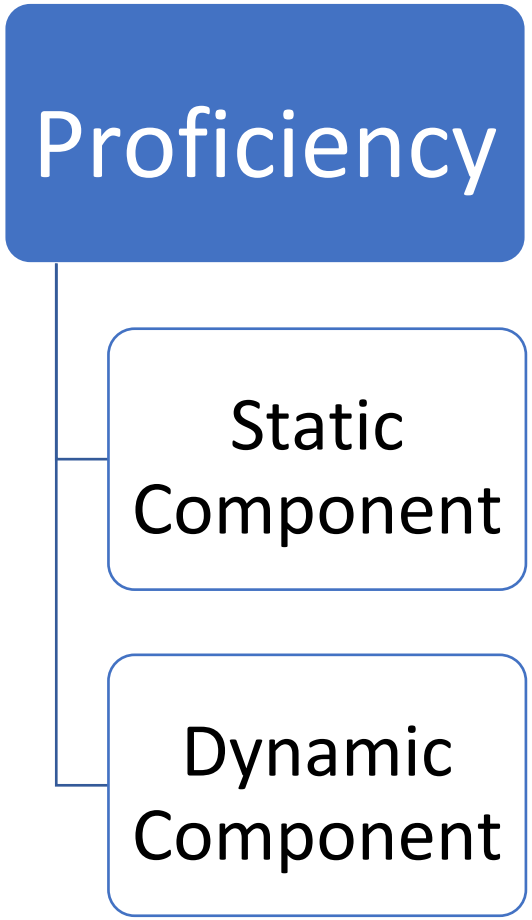
The Rules

- Classical Test Theory (early XX)
  - linear linking $Y_j = \theta_j + \varepsilon_j$
  - **easy to understand**
  - **proficiency measures depend on test difficulty**
- Item Response Theory (middle XX)
  - nonlinear linking $Logit(\pi_{ij}|\theta_j) = \ln(\pi_{ij}/1 - \pi_{ij}) = \theta_j - \delta_i$
  - **independence of measures**
  - **proficiency is constant**

In the study we…

1. propose IRT extensions, which model **the growth** of student's proficiency **with attempts**
2. illustrate these extensions using MOOC data
3. check **the ability to predict correctness** of students' responses using a cross-validation procedure

Model of Proficiency



Data for Illustration

“Economics for Non-Economists” MOOC on Coursera

This course is taught in Russian

Russia (72%), Ukraine (8.4%), Kazakhstan (3.9%), Belarus (3.2%), USA (1.2%), other countries (11.3%).

We used the data from the first module of the course

During this study, the number of students who attended the module was 1609

The weekly summative assessment includes 10 items

The number of responses is 51,550

Students used 2.04 attempts in average, the standard deviation is 1.52

Results

			Basic IRT	Extension 1	Extension 2
Fixed	*Intercept*		0.63 (0.22)	0.27 (0.25)	0.29 (0.27)
	Attempt			0.92 (0.03)	0.90 (0.06)
Random	*Intercept*	*Student*	0.78	0.92	0.96
		Item	1.01	1.12	1.22
	Attempt	*Student*		0.60	0.59
		Item			0.21
AIC			58779	55401	54929

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- The effect per additional attempt is lower for students who use a relatively higher number of attempts.
  - *Learn through attempts vs. Guessing (Box-Ticking)*
- Students, active with video lectures and productive with formative assessments, have higher chances to solve items correctly.
- Overall accuracy in predicting student's item responses using the extensions is 6% higher than using the basic IRT model

Thank you!