

# Я опять летал во сне: Как измерить прирост подготовленности студентов в онлайн-курсах

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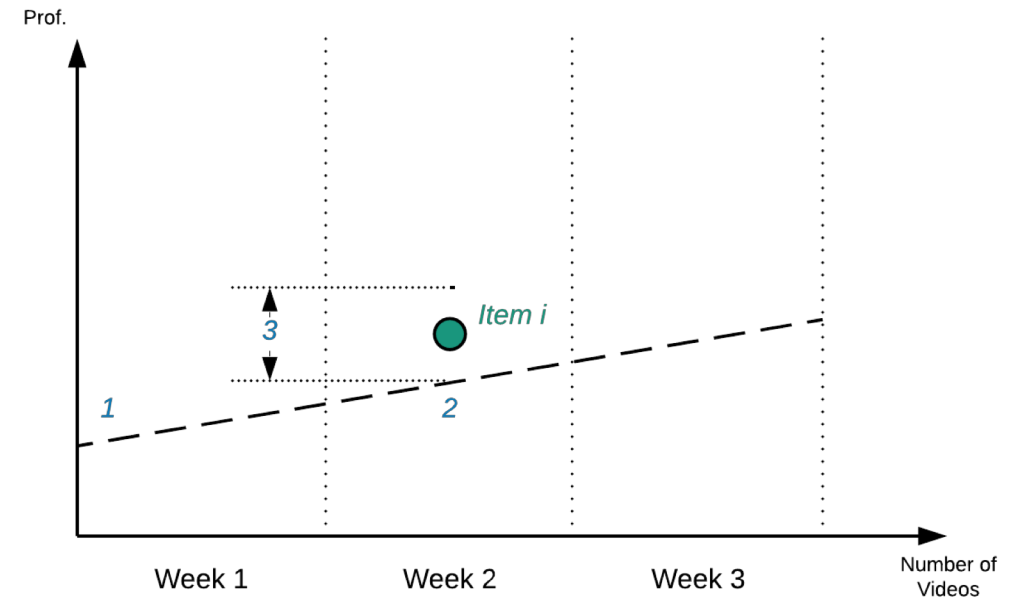


# Что науке известно?

- Подготовленность
  - Item Response Theory (G. Rasch, F. Lord, 1960-e)
    - подготовленность – константа
- Прирост
  - Bayes Knowledge Tracing (Corbett & Anderson, 1985)
    - прирост одинаков для всех
- ... долгое время всех все устраивало
- Прирост подготовленности
  - Computational Psychometrics (Kadengye, Ceulemans, & Van den Noortgate, 2014, 2015)
    - в MOOC не так просто отследить время сеанса

# Новый взгляд на моделирование прироста

- Видео – центральный элемент контента MOOK
  - рост внутри курса
- Попытка – новый вид взаимодействия с заданием в MOOK
  - локальный рост (внутри единицы содержания)



# Расширения модели Г. Раша

Модель Г. Раша

$$\begin{aligned} \text{Logit}(\pi_{ij}|\theta_j) &= \ln(\pi_{ij}/1 - \pi_{ij}) \\ &= \theta_j - \delta_i \text{ and } Y_{ij} \sim \text{Bernoulli}(\pi_{ij}) \end{aligned}$$

$$\begin{aligned} \text{Logit}(\pi_{ij}|\theta_j) &= \ln\left(\frac{\pi_{ij}}{1} - \pi_{ij}\right) \\ &= \theta_j + t_{lji}\gamma_j + t_{aji}\gamma_j - \delta_i \text{ and } Y_{ij} \sim \text{Bernoulli}(\pi_{ij}) \end{aligned}$$

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# Результаты

**Table 2** Parameters of the extension for Course 1

			Rasch model (Eq. 5)	Extension with fixed growth effects (Eq. 6)	Extension with random growth effects and univariate distribution (Eq. 7)	Extension with correlated random growth effects and multivariate distribution (Eq. 7)		
Fixed	Intercept	$b_0$	0.96 (0.09)	− 0.52 (0.16)	− 0.38 (0.17)	− 0.32 (0.17)		
	Video	$b_1$		4.45 (0.45)	3.71 (0.50)	3.72 (0.46)		
	Attempt	$b_2$		0.43 (0.01)	0.80 (0.02)	0.82 (0.02)		
Random	Student	Intercept	$\sigma_{u1}$	0.72	0.79	0.80	0.95	Corr.
		Video	$\sigma_{b1}$			1.52	2.07	− .67
		Attempt	$\sigma_{b2}$			0.52	0.51	.14
	Item	Intercept	$\sigma_{u2}$	1.03	1.09	1.09	1.08	.02
AIC				146,979	143,024	140,367	140,221	

In the table, Course 1 is “Economics for Non-Economists” (Higher School of Economics, [n.d.-a](#)). For fixed effects, standard errors are presented in parentheses. For random effects, standard deviations are presented

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# Результаты

**Table 3** Dynamics of antilogits throughout Course 1

	Start	Week 1			Week 5		
	Avg.	Avg.	– <i>SD</i>	+ <i>SD</i>	Avg.	– <i>SD</i>	+ <i>SD</i>
Rasch model (Eq. 5)	.72	.72			.72		
Extension with fixed growth effects (Eq. 6)	.37	.47			.83		
Extension with random growth effects and univariate distribution (Eq. 7)	.41	.49	.45	.52	.80	.66	.89
Extension with correlated random growth effects and multivariate distribution (Eq. 7)	.42	.50	.46	.55	.81	.62	.92

In the table, antilogits for a student with average (initial) ability and for an item with average difficulty are presented. The dynamics of antilogits for the start, the end of the first week, and the end of the fifth week of the course are presented. For the model with random growth effects, the average, one standard deviation lower than the average, and one standard deviation higher than the average continuous growth effect are presented. Course 1 is “Economics for Non-Economists” (Higher School of Economics, [n.d.-a](#))

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# Результаты

**Table 4** Dynamics of antilogits with attempts in Course 1

	Att. 1	Attempt 2			Attempt 3		
	Avg.	Avg.	– <i>SD</i>	+ <i>SD</i>	Avg.	– <i>SD</i>	+ <i>SD</i>
Rasch model (Eq. 5)	.72	.72			.72		
Extension with fixed growth effects(Eq. 6)	.37	.48			.58		
Extension with random growth effects and univariate distribution (Eq. 7)	.41	.60	.48	.72	.77	.54	.91
Extension with correlated random growth effects and multivariate distribution (Eq. 7)	.42	.62	.50	.73	.79	.57	.91

In the table, antilogits for a student with average ability and for an item with average difficulty at the start of the course are presented. The dynamics of antilogits for the first, second, and third attempts are presented. For the model with random growth effects, the average, one standard deviation lower than the average, and one standard deviation higher than the average local growth effect are presented. Course 1 is “Economics for Non-Economists” (Higher School of Economics, [n.d.-a](#))

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# Результаты

**Table 7** Accuracy in predicting correctness

	Overall		Course 1		Course 2		Course 3	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Rasch model	.743	.047	.724	.002	.699	.002	.806	.000
Extension with fixed growth effects	.760	.038	.737	.002	.732	.002	.812	.001
Extension with random growth effects and univariate distribution	.766	.034	.747	.002	.740	.001	.813	.001
Extension with random growth effects and multivariate distribution	.766	.034	.747	.002	.739	.001	.812	.001

In the table, Course 1 is “Economics for Non-Economists” (Higher School of Economics, [n.d.-a](#)), Course 2 is “Game Theory” (Higher School of Economics, [n.d.-b](#)), and Course 3 is “Introduction to Neuroeconomics: How the Brain Makes Decisions” (Higher School of Economics, [n.d.-c](#))

# Ограничения

- Подходит для post-hoc измерений
- Не подходит для трекинга в режиме реального времени
- Но мы над этим работаем 😊

# Где можно применять?

- В аналитических дэшбордах
- В рекомендательных и навигационных движках

# А где почитать?

Abbakumov D., Desmet P., Van den Noortgate W. (2018). Measuring growth in students' proficiency in MOOCs: Two component dynamic extensions for the Rasch model. *Behavior Research Methods*.

Ссылка: <https://rdcu.be/7Xxo>

Спасибо!