

QUESTIONNAIRES AND BEYOND: THE RASCH MODEL

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1 The intuition

2 The model

3 Wait...

4 Why is it useful?

5 Closing time

Q1

$$4 + 5 = ?$$

Q2

$$\frac{3}{2}x^2 + \frac{5}{4}x = ?$$

Q1

$$4 + 5 = ?$$

d_{q1}

Q2

$$\frac{3}{2}x^2 + \frac{5}{4}x = ?$$

d_{q2}



A_{Bart}

Q1

$$4 + 5 = ?$$

d_{q1}

Q2

$$\frac{3}{2}x^2 + \frac{5}{4}x = ?$$

d_{q2}



A_{Lisa}



A_{Bart}

Q1

$$4 + 5 = ?$$

d_{q1}

Q2

$$\frac{3}{2}x^2 + \frac{5}{4}x = ?$$

d_{q2}



A_{Lisa}

$$\frac{A_p}{d_i} \quad (1)$$

$$> 1 \text{ if } A_p > d_i$$

$$< 1 \text{ if } A_p < d_i$$

$$P(X_{pi} = 1) = \frac{\frac{A_p}{d_i}}{1 + \frac{A_p}{d_i}} \quad (2)$$

① The intuition

② **The model**

③ Wait...

④ Why is it useful?

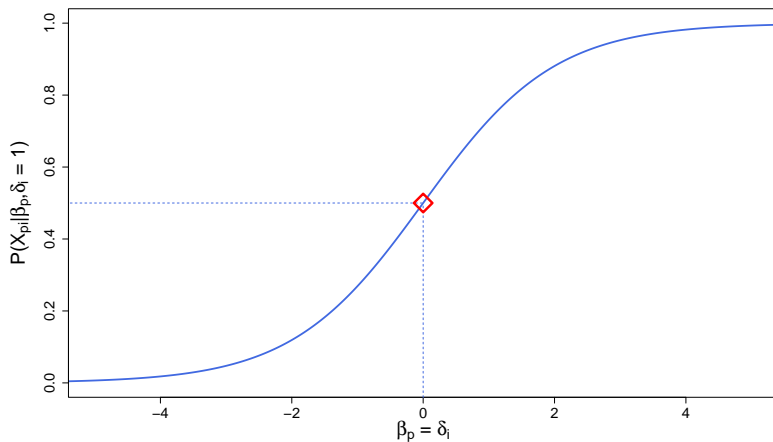
⑤ Closing time



$$\ln(A_p) = \beta_p$$

$$\ln(d_i) = \delta_i$$

$$P(X_{pi}|\beta_p, \delta_i) = \frac{\exp(\beta_p - \delta_i)}{1 + \exp(\beta_p - \delta_i)} \quad (3)$$



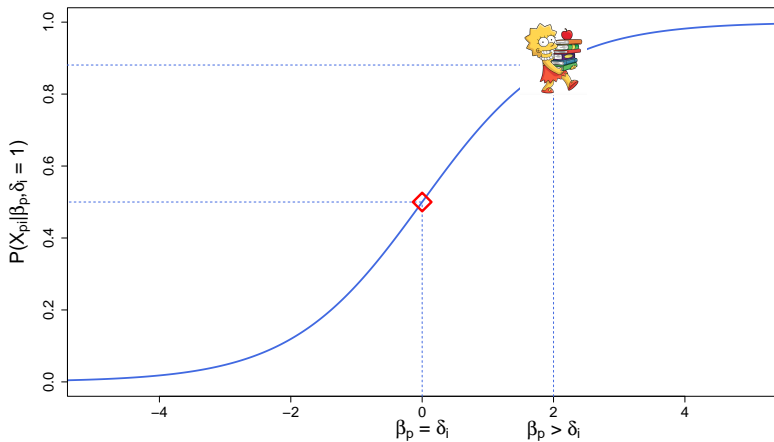
The intuition
○○

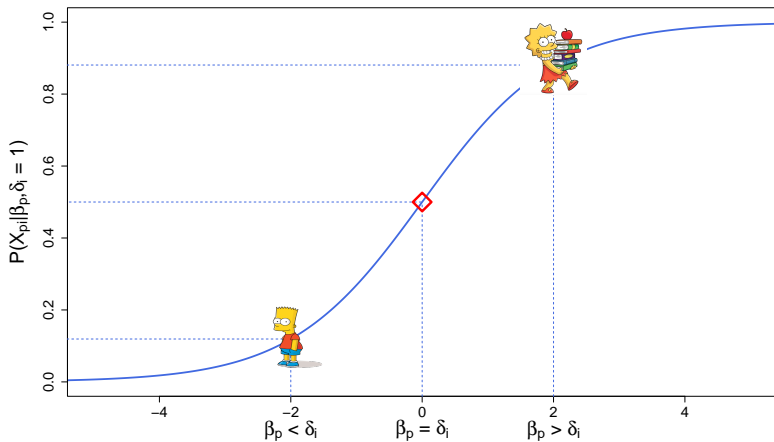
The model
○○●

Wait...
○○

Why is it useful?
○○○○

Closing time
○○○





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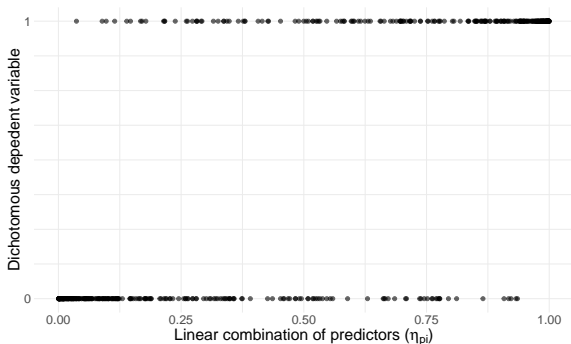
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Generalized Linear Model (GLM)

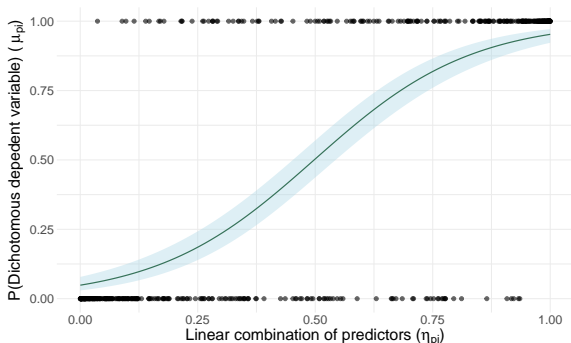
binomially distributed responses

Generalized Linear Model (GLM) binomially distributed responses



$$\mu_{pi} = g(\eta_{pi}) = \log \left(\frac{\mu_{pi}}{1 - \mu_{pi}} \right)$$

Generalized Linear Model (GLM) binomially distributed responses



$$\mu_{pi} = g(\eta_{pi}) = \log \left(\frac{\mu_{pi}}{1 - \mu_{pi}} \right)$$

$$g^{-1} = \frac{\exp(\eta_{pi})}{1 + \exp(\eta_{pi})}$$

① The intuition

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④ **Why is it useful?**

⑤ Closing time

Rasch model: Dichotomous responses

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Issue

Quite limiting in Psychological Research

Rasch model: Dichotomous responses

Issue

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(Generalized) Linear Model: “Any” kind of response

Rasch model: Dichotomous responses

Issue

Quite limiting in Psychological Research

(Generalized) Linear Model: “Any” kind of response

e.g.: Response times

log-transformation and log-normal model parametrization

- **Linearity of the scores**

Logarithm transformation → Respondents and items on the same latent trait

- **Comparison invariance**

Respondents can be compared between each other without considering the items....and vice versa!

- **Local independence**

Given the person → The responses to the items are independent

- **Linearity of the scores**

Logarithm transformation → Respondents and items on the same latent trait



















- **Comparison invariance**



















Respondents can be compared between each other without considering the items....and vice versa!

- **Local independence**

Given the person → The responses to the items are independent



















Unidimensionality

	Condition A			Condition B		
Francesco						
Giulia						
Jessica						

	Condition A			Condition B		
Francesco						
Giulia						
Jessica						



Local independence



















	Condition A			Condition B		
Francesco						
Giulia						
Jessica						



Local independence

Rasch model

Generalized Linear Model

	Condition A			Condition B		
Francesco						
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Local independence

Rasch model

- Can't be applied
- The estimates would make no sense

Generalized Linear Model

- Add the random part (Go Mixed)
- Obtain a Rasch-like parametrization of the data

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Think outside of the box!



Yes



But

Think outside of the box!



Yes



But

Rasch estimates

Think outside of the box!

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But

Rasch-like parametrization

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Rasch estimates

The sky is the limit

But

Rasch-like parametrization

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Rasch estimates

The sky is the limit

Keep it maximal

But

Rasch-like parametrization

Don't over complicate things

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Rasch-like parametrization
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Thank you