

# 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

The intuition  
●●

The model  
○○○

Wait...  
○○○

Why is it useful?  
○○○○

Closing time  
○○○○



$A_{\text{Bart}}$



$A_{\text{Lisa}}$



$A_{\text{Bart}}$

**Q1**

$$4 + 5 = ?$$

$d_{q1}$

**Q2**

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

$d_{q2}$



$A_{\text{Lisa}}$



$A_{\text{Bart}}$

**Q1**

$$4 + 5 = ?$$

$d_{q1}$

**Q2**

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

$d_{q2}$



$A_{\text{Lisa}}$

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

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

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

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

① The intuition

② **The model**

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

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

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

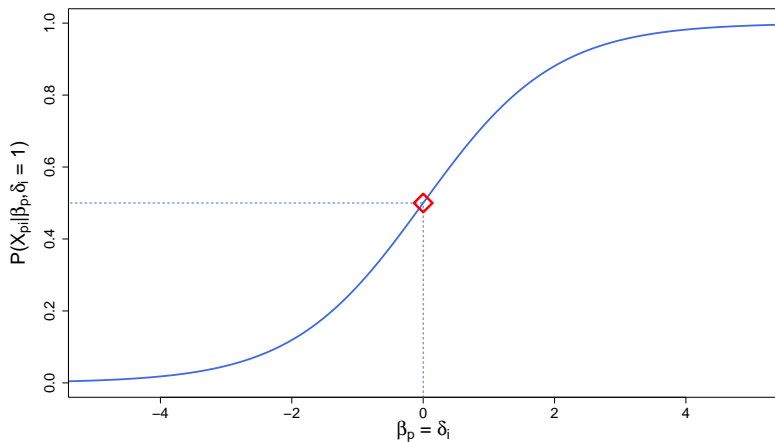
The intuition  
○○

The model  
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Wait...  
○○○

Why is it useful?  
○○○○

Closing time  
○○○○○





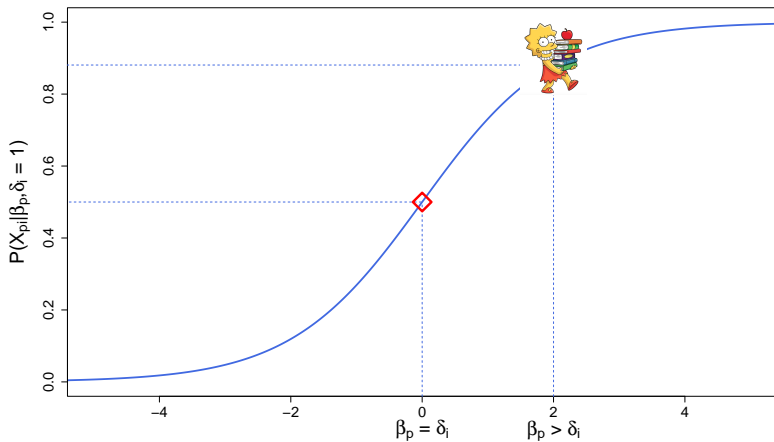
The intuition  
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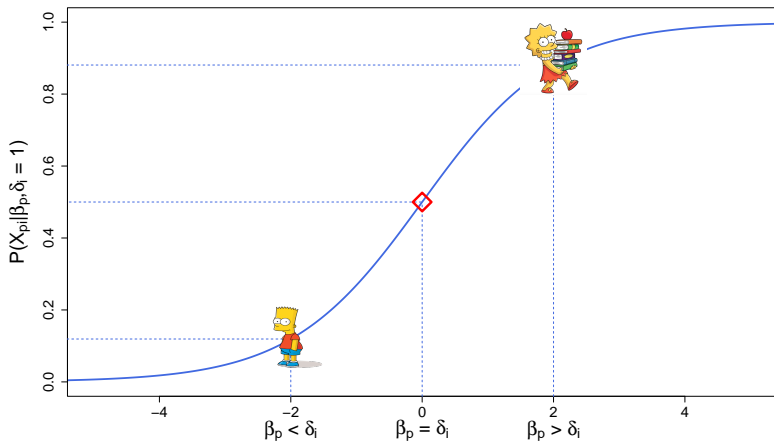
The intuition  
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\* Eureka moment \*

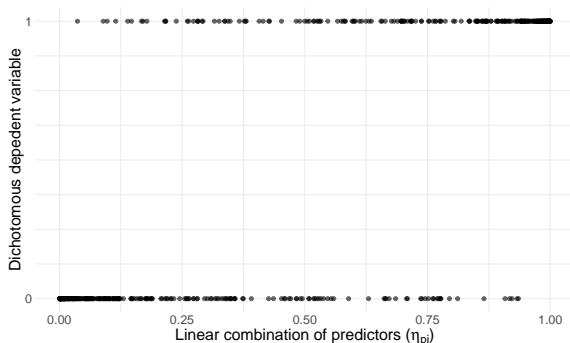


STATISTICS IS ~~ART~~  HARD

# Generalized Linear Model (GLM)

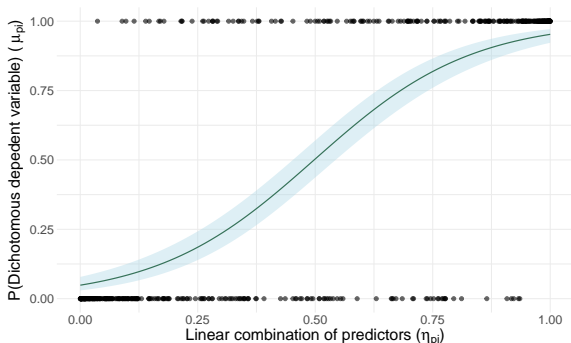
## binomially distributed responses

# 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

② The model

③ Wait...

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

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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*

## Unidimensionality

- **Linearity of the scores**

*Logarithm transformation → Respondents and items on the same latent trait*

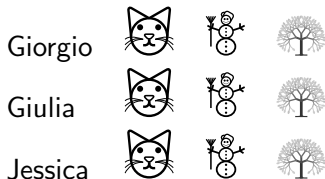
- **Comparison invariance**

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

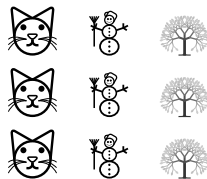
- **Local independence**



















*Given the person → The responses to the items are independent*

### Condition A



### Condition B

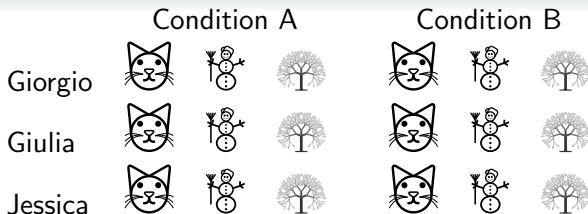


	Condition A			Condition B		
Giorgio						
Giulia						
Jessica						



**Local independence**

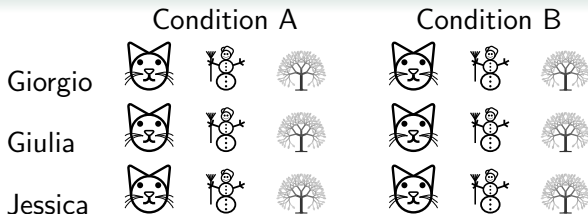




**Local independence**

Rasch model

Generalized Linear Model



## 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

Rasch estimates

The sky is the limit

Keep it maximal

---

But

Rasch-like parametrization

Don't over complicate things

Keep it minimal

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Thank you

# Questions!



<https://ottaviae.github.io/AIP2022/Rasch/epifaniaRasch.pdf>