QUESTIONNAIRES AND BEYOND: THE RASCH MODEL

Ottavia M. Epifania
ottavia.epifania@unipd.it
Univeristy of Padova
Catholic University of the Sacred Heart

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Statistics is Art

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}

Q1

$$4 + 5 = ?$$

d_{q1}

Q2

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

d_{q2}

A_{Bart}

A_{Lisa}

$$\frac{A_p}{d_i} \tag{1}$$

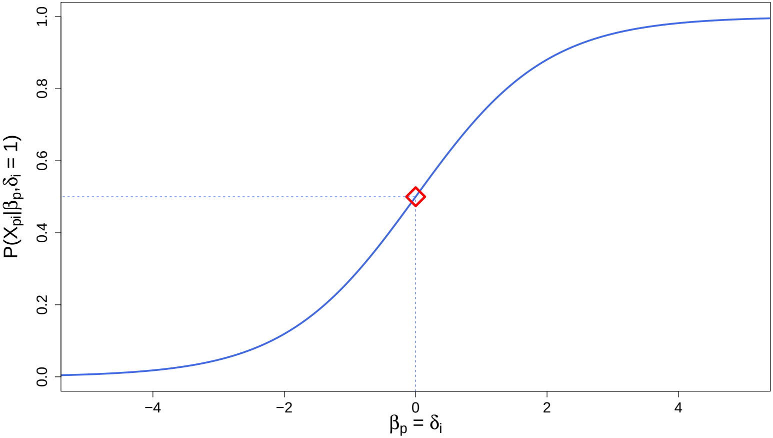
> 1 if $A_p > d_i$

< 1 if $A_p < d_i$

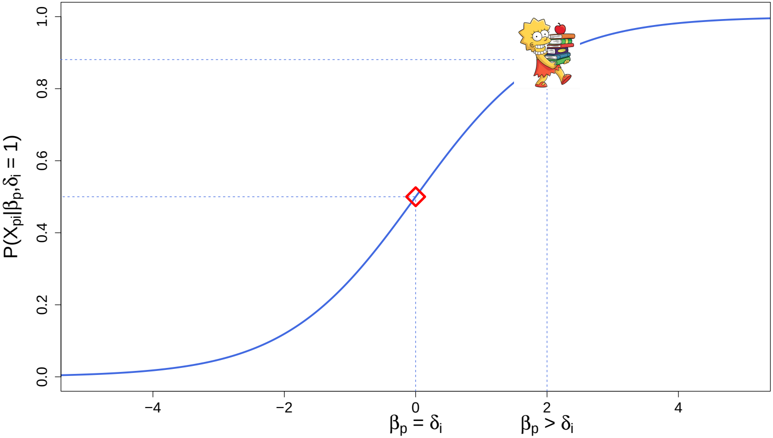
$$P(X_{pi} = 1) = \frac{\frac{A_p}{d_i}}{1 + \frac{A_p}{d_i}} \tag{2}$$

$$ln(A_p) = \beta_p \qquad\qquad ln(d_i) = \delta_i$$

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



1.0
0.8
0.6
0.4
0.2
0.0
P(X_pi|β_p,δ_i = 1)
−4
−2
0
2
4
β_p = δ_i


$P(X_{pi}|\beta_p,\delta_i = 1)$
1.0
0.8
0.6
0.4
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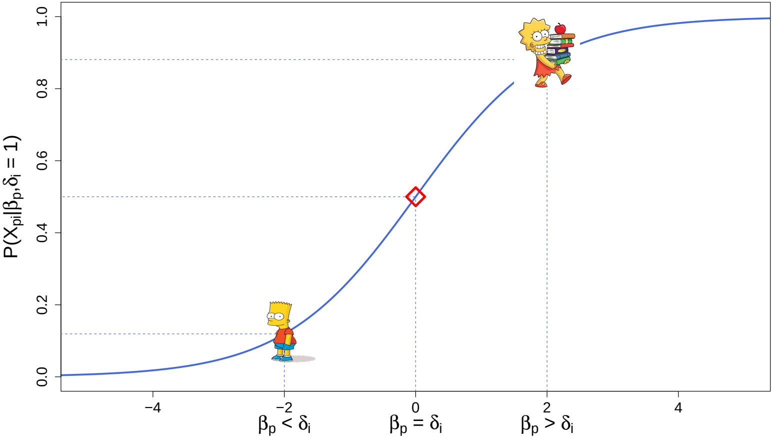
0.0
−4
−2
0
2
4
$\beta_p = \delta_i$
$\beta_p > \delta_i$



$P(X_{pi}|\beta_p,\delta_i = 1)$
0.0
0.2
0.4
0.6
0.8
1.0
−4
−2
0
2
4
$\beta_p < \delta_i$
$\beta_p = \delta_i$
$\beta_p > \delta_i$

* Eureka moment *

ΣΨ PSICOSTAT

Statistics is ~~Hard~~ ART

Generalized Linear Model (GLM)
binomially distributed responses

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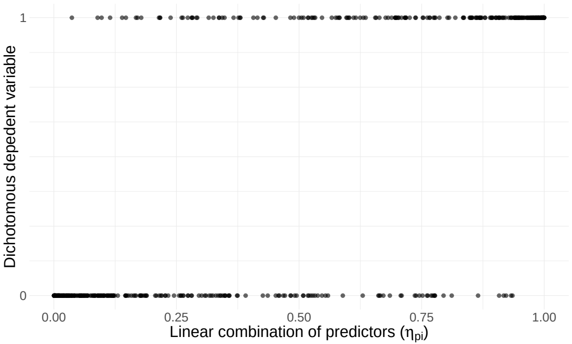
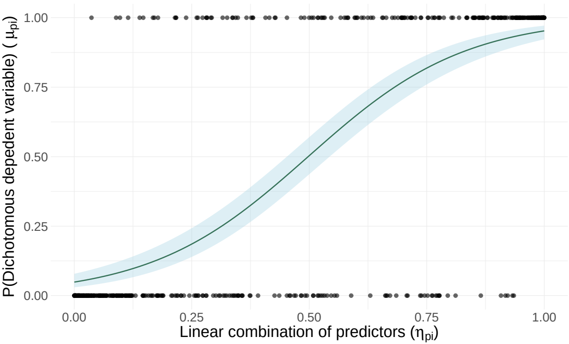
binomially distributed responses



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

Generalized Linear Model (GLM)
binomially distributed responses



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

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

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

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- **Local independence**

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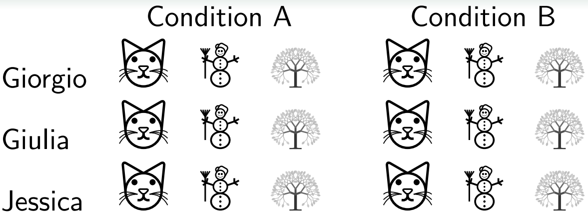
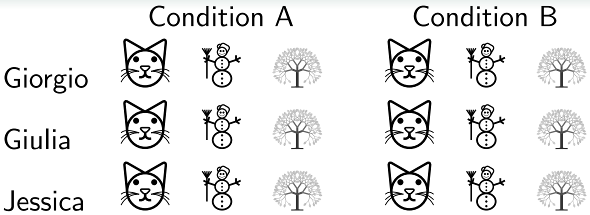
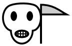

Condition A
Condition B
Giorgio
Giulia
Jessica




Local independence

Condition A Condition B

Giorgio

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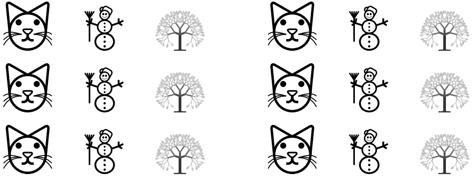

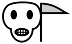

Local independence

Rasch model

Generalized Linear Model

Condition A Condition B

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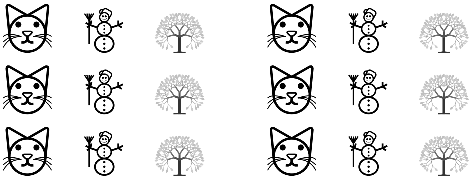

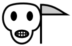

Local independence

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

Think outside of the box!

Yes

But

Think outside of the box!

Yes	But
Rasch estimates	

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Rasch-like parametrization

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Yes	But
Rasch estimates	Rasch-like parametrization
The sky is the limit	Don't over complicate things
Keep it maximal	Keep it minimal

Thank you

Questions!

ASK ME!