

Agenda

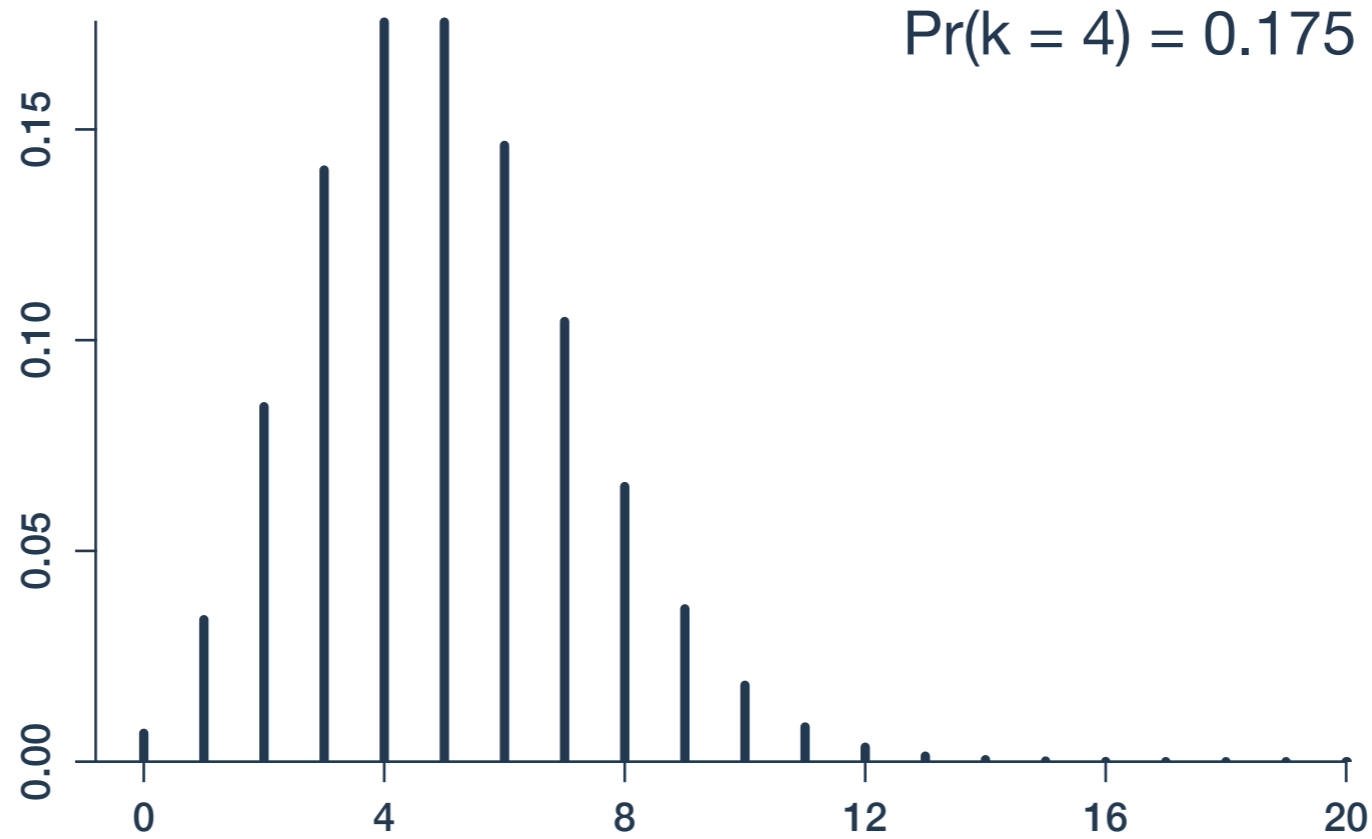
1. Cumulative probability distributions
2. Predicting educational attainment
3. Log cumulative odds link
4. Intercept-only ordered logit
5. Ordered logit with predictors
6. Estimating ordered logit in R

See also: Michael Betancourt's more technical introduction to ordered logit:

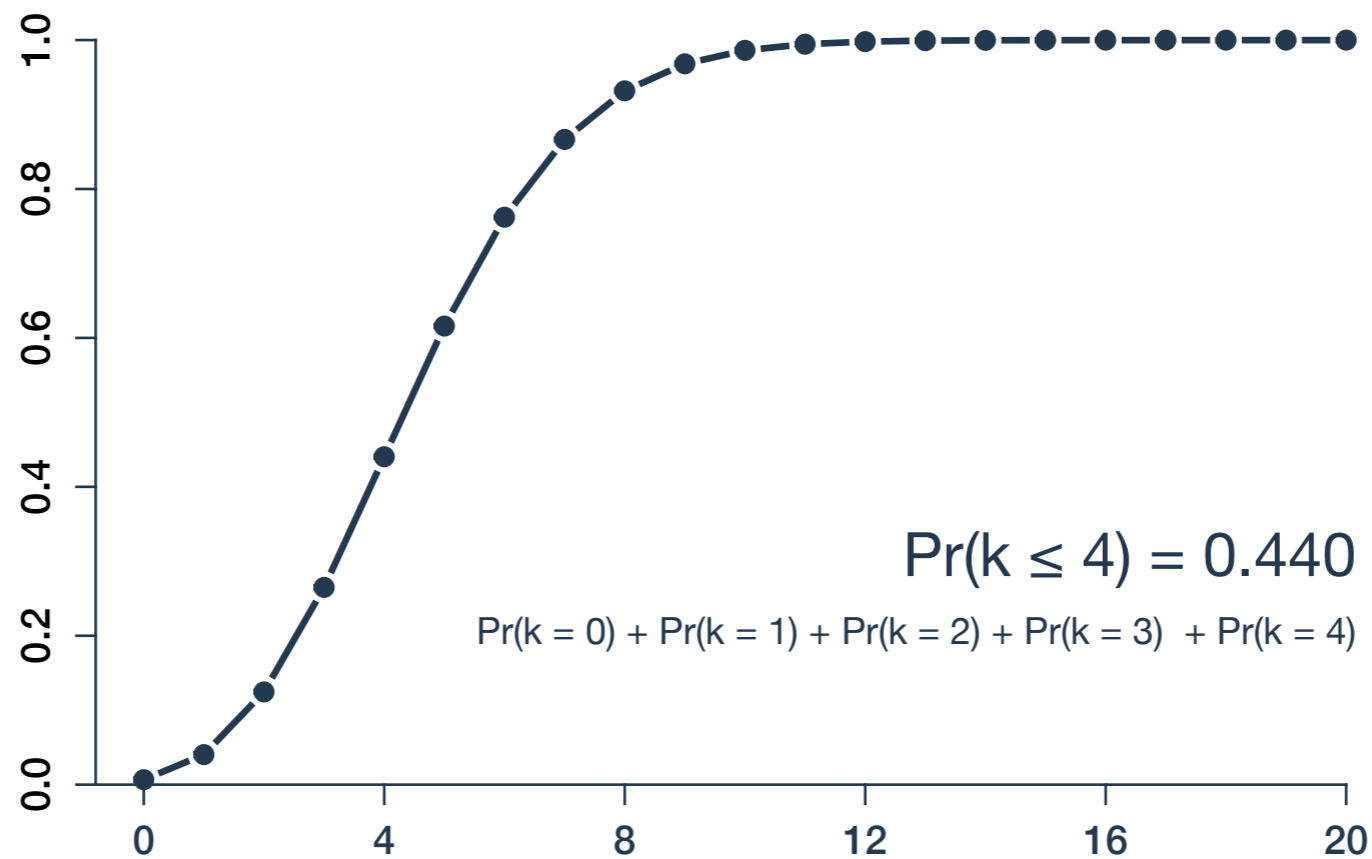
https://betanalpha.github.io/assets/case_studies/ordinal_regression.html

Cumulative probability distributions

Probability
mass function
(PMF)
Pois(5)



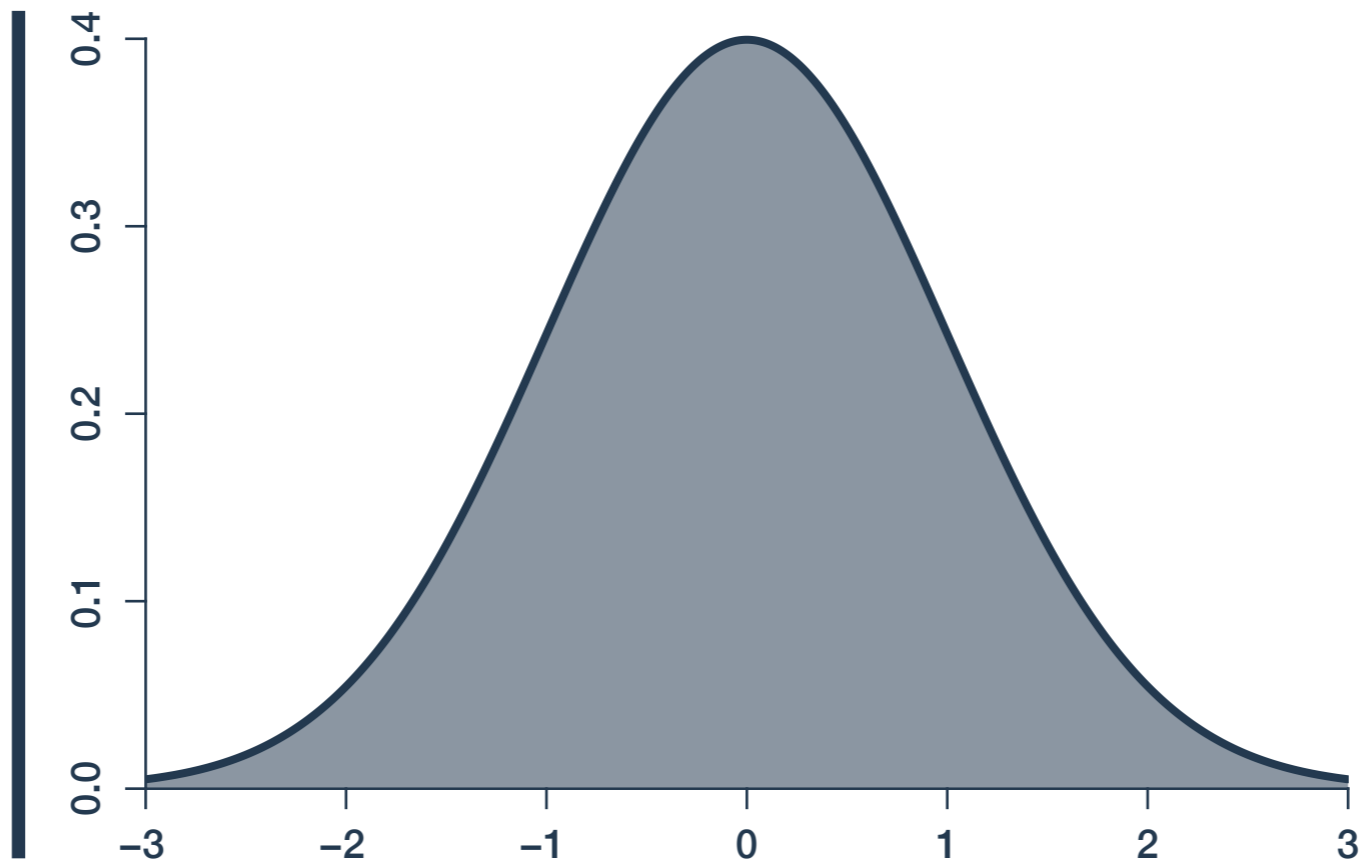
Cumulative
distribution
function
(CDF)
Pois(5)



Cumulative probability distributions

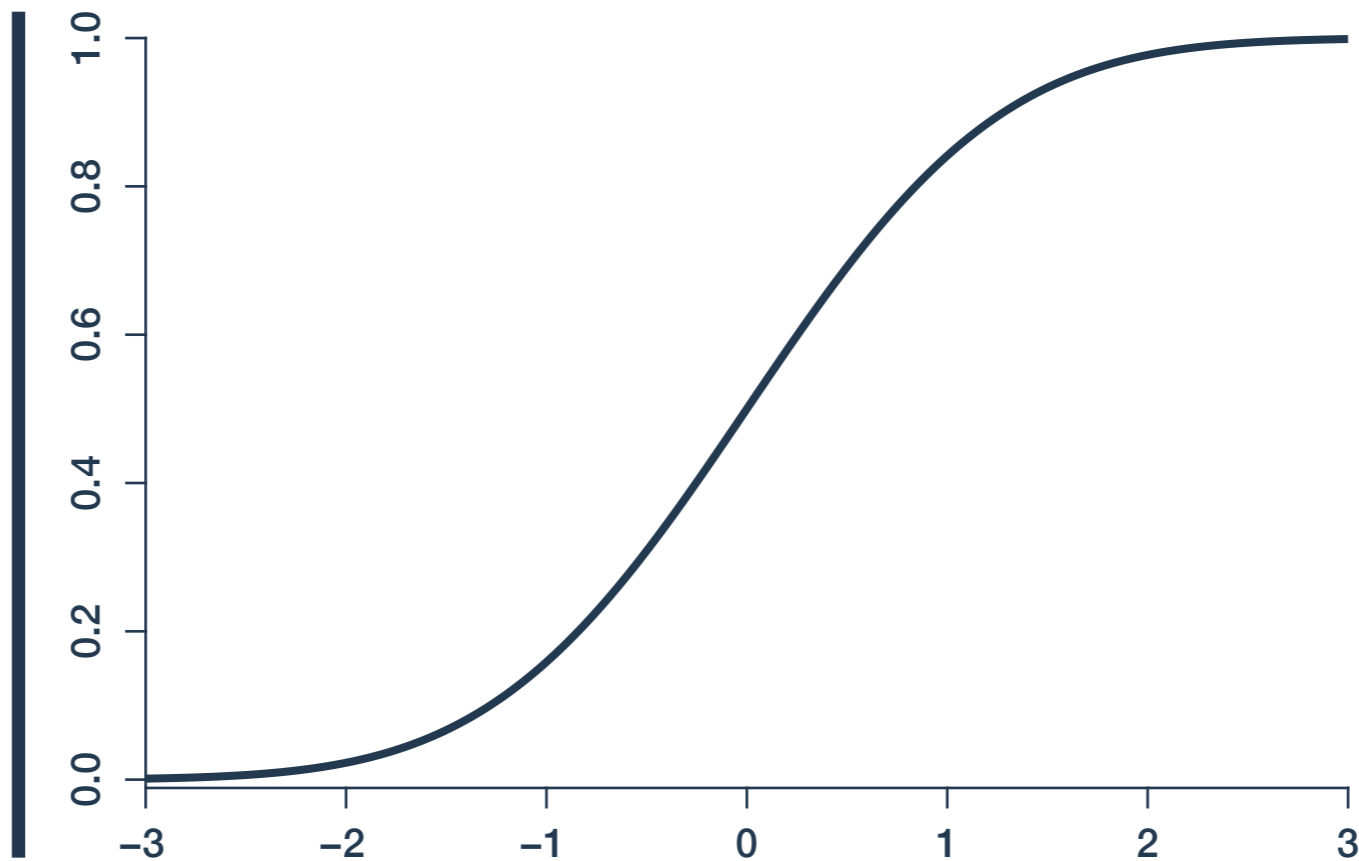
**Probability
density
function
(PDF)**

Norm(0, 1)

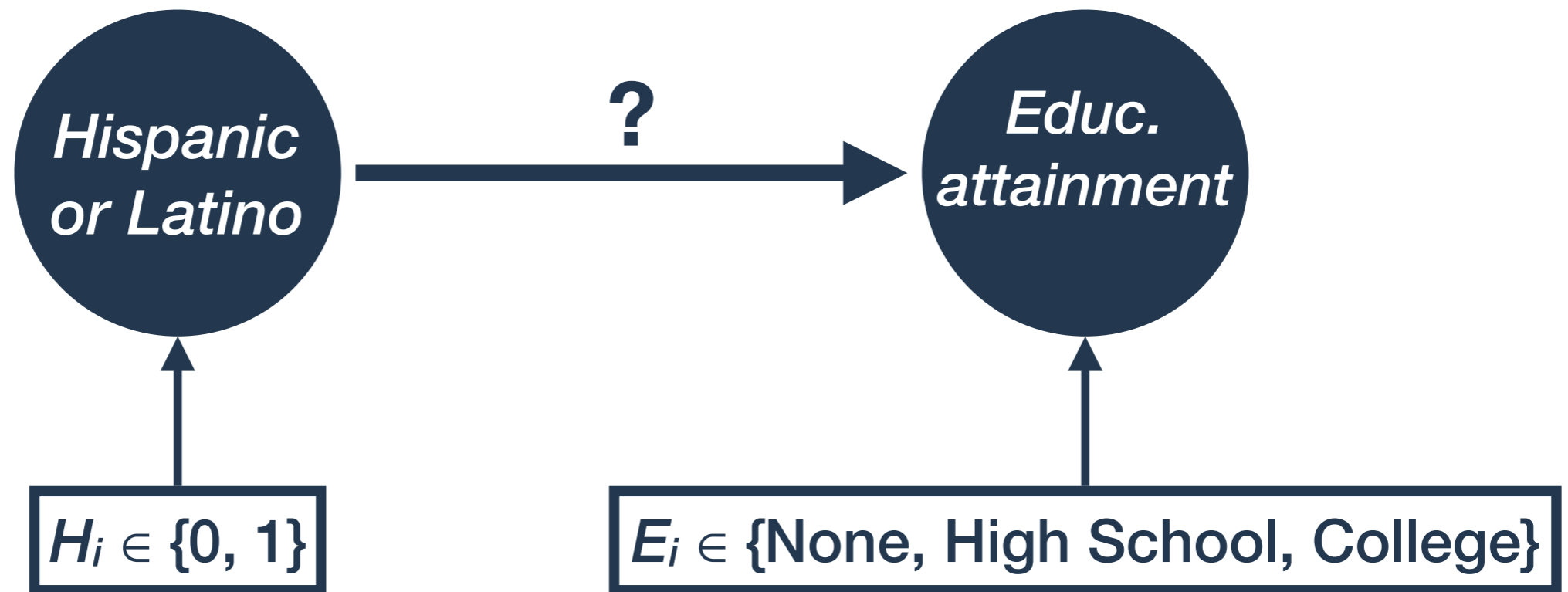


**Cumulative
distribution
function
(CDF)**

Norm(0, 1)



Age and education



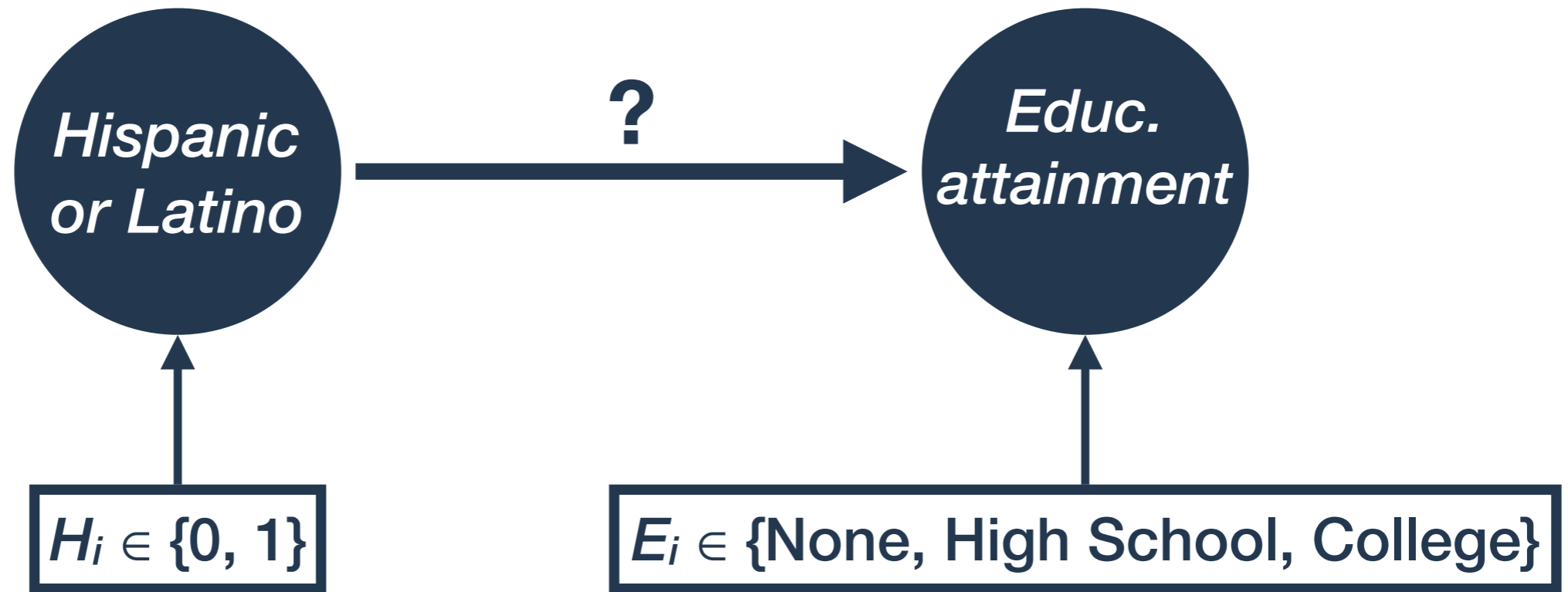
The problem

Educational attainment is measured as categories, but those categories are ordered in an important way.

The solution

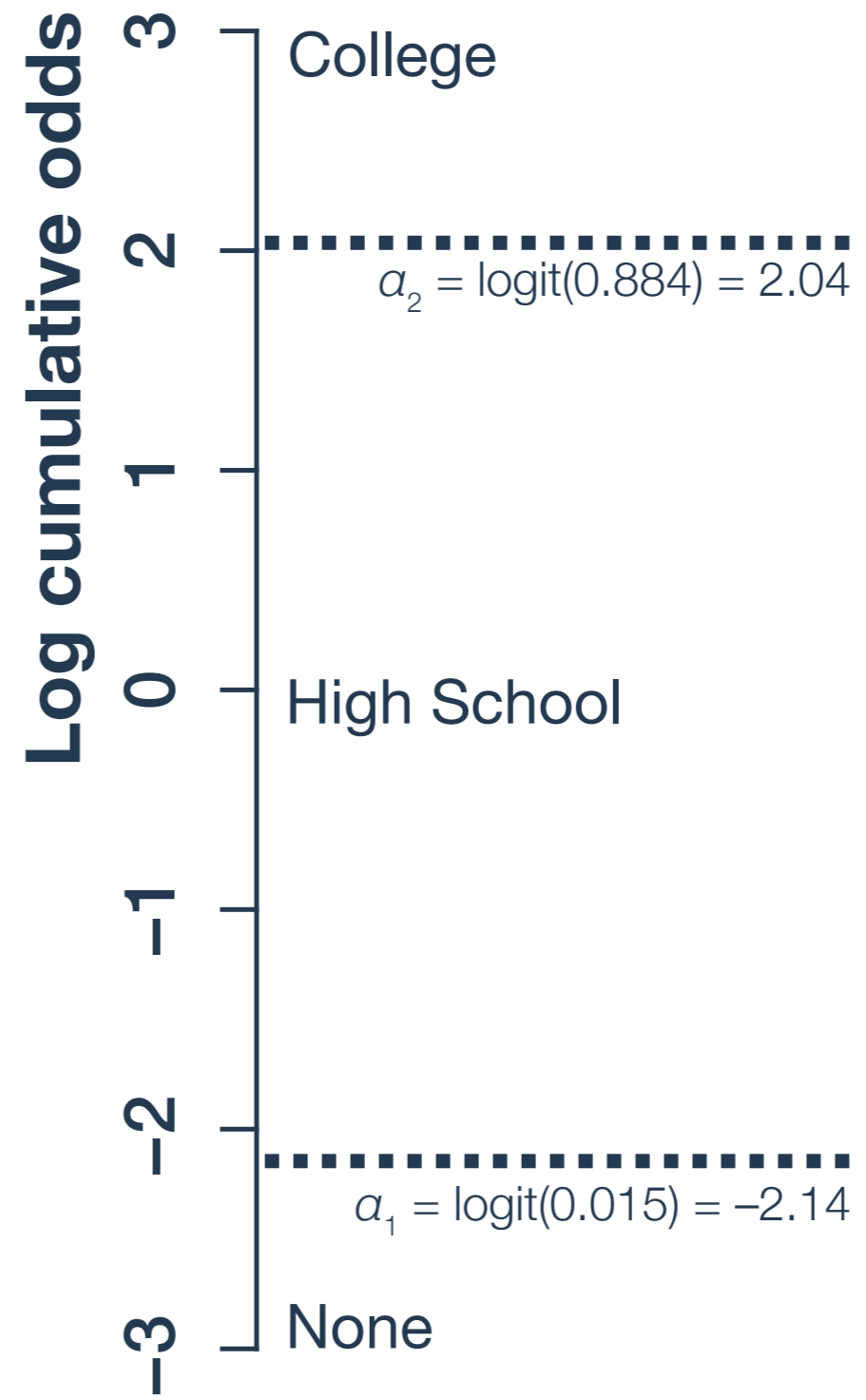
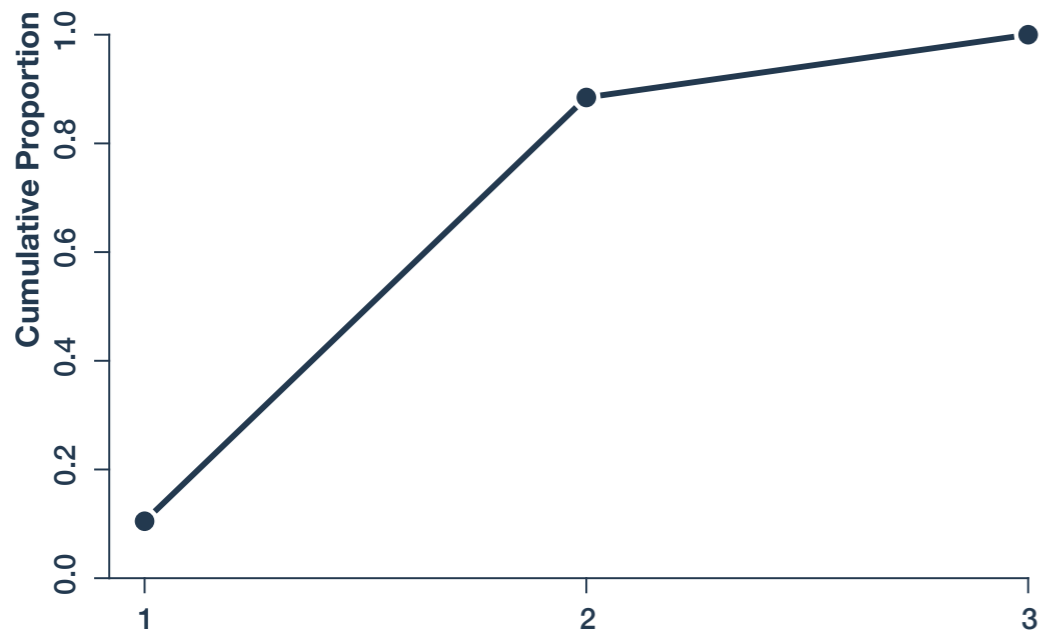
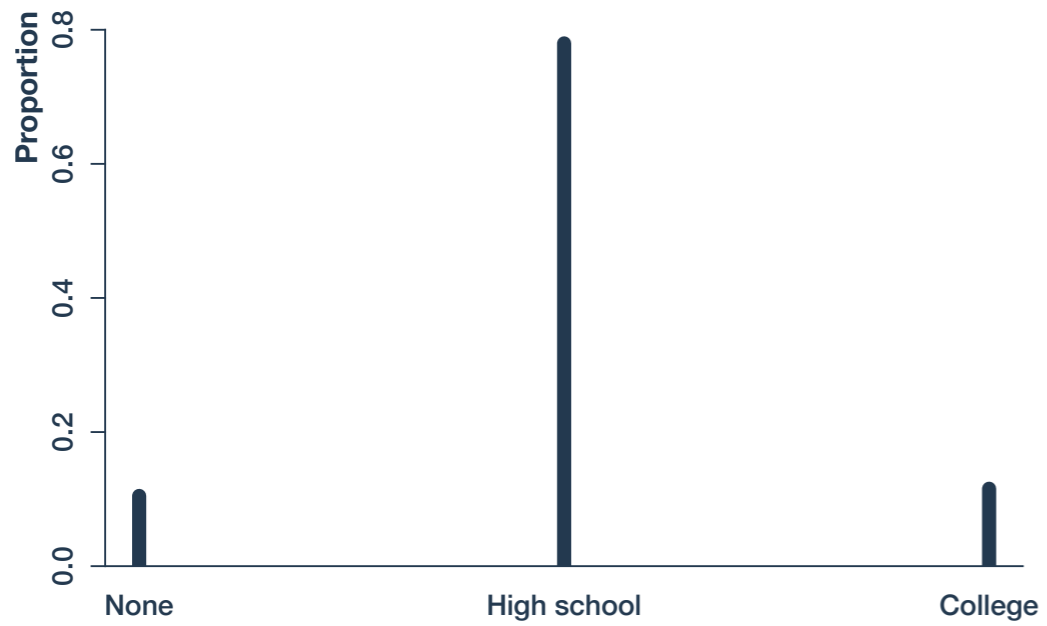
Treat education as a categorically-distributed variable, but constrain the probabilities to respect the order.

Age and education



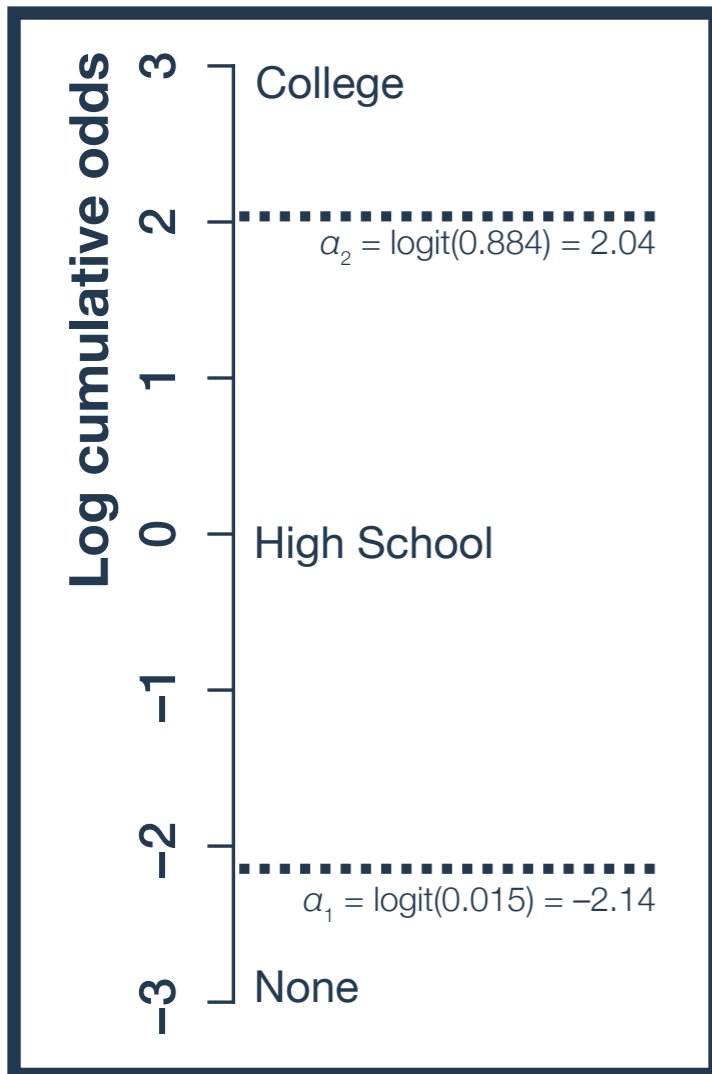
$$E_i \sim \text{Categorical}(p_1, p_2, p_3)$$

Log cumulative odds



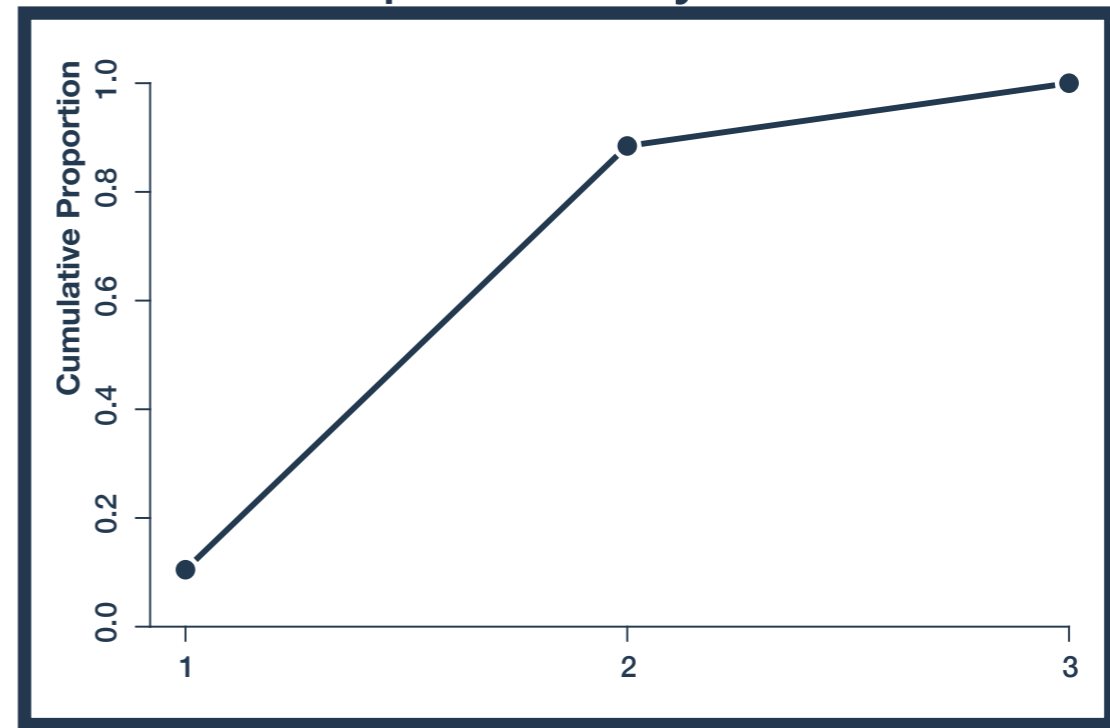
Log cumulative odds

Parameter scale



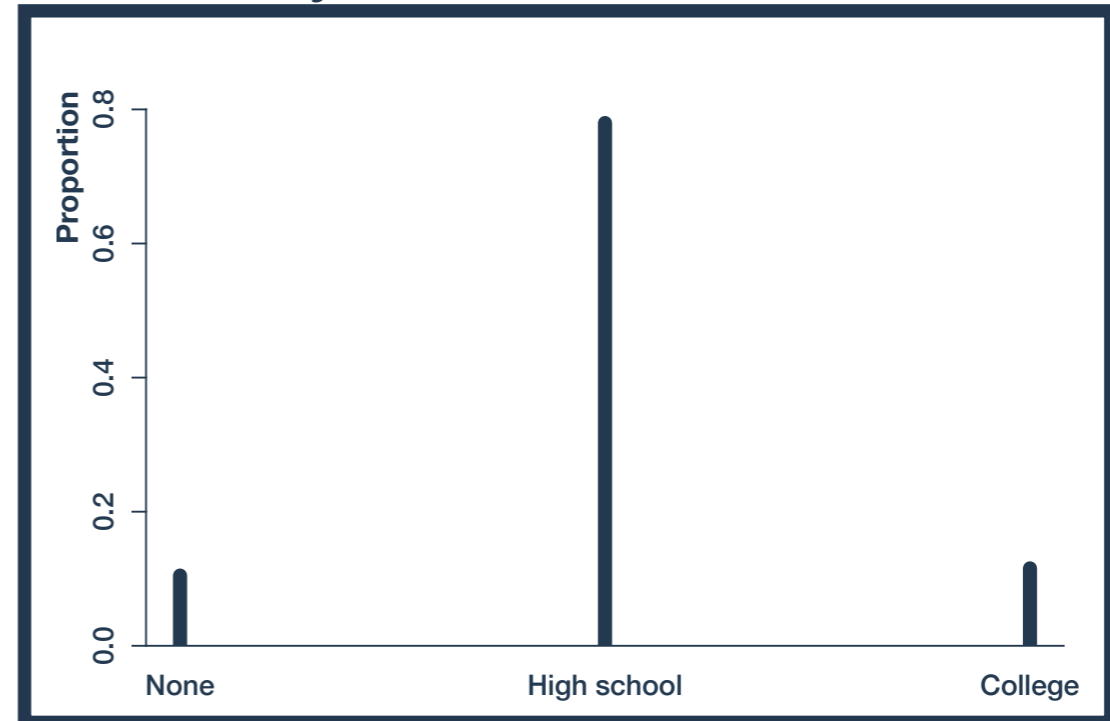
Inverse logit

Cumulative probability



Subtraction

Probability



Ordered logit model

Intercept-only
ordered logit
model

$$E_i \sim \text{Categorical}(\mathbf{p})$$

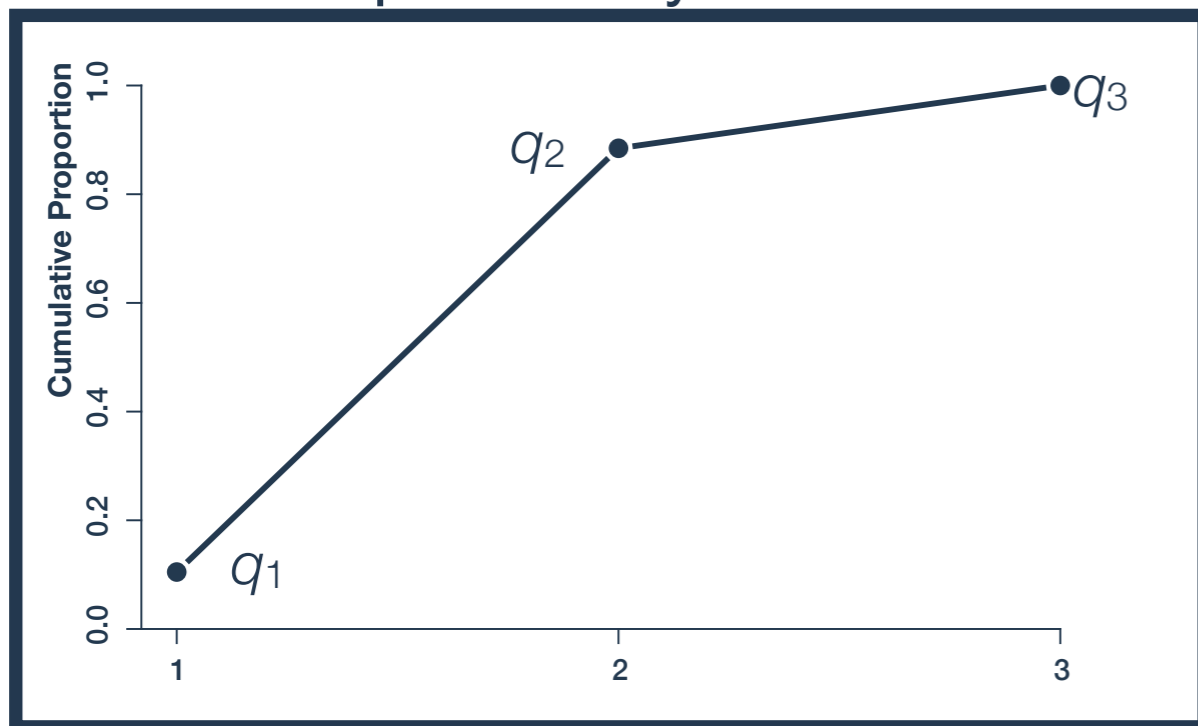
$$p_k = q_k - q_{k-1}$$

$$\text{logit}(q_k) = a_k$$

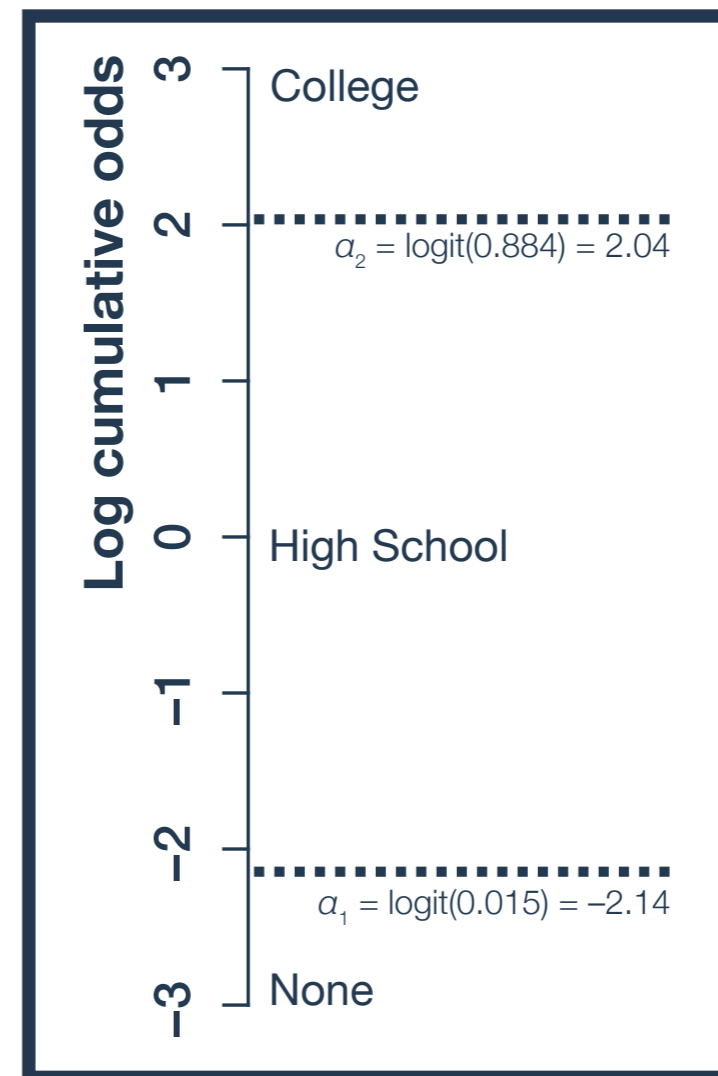
q_k is the cumulative
probability of category k

$$q_0 = 0; q_k = 1$$

Cumulative probability



Parameter scale



Ordered logit model

Ordered logit with predictors

$$E_i \sim \text{Categorical}(\mathbf{p})$$

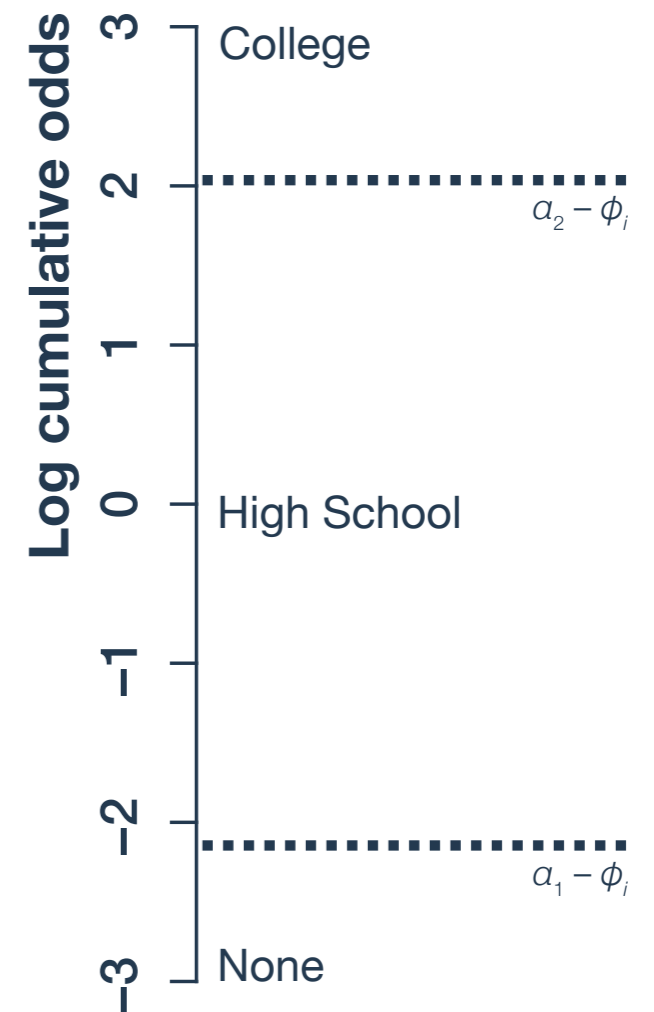
$$p_k = q_k - q_{k-1}$$

$$\text{logit}(q_k) = a_k - \phi_i$$

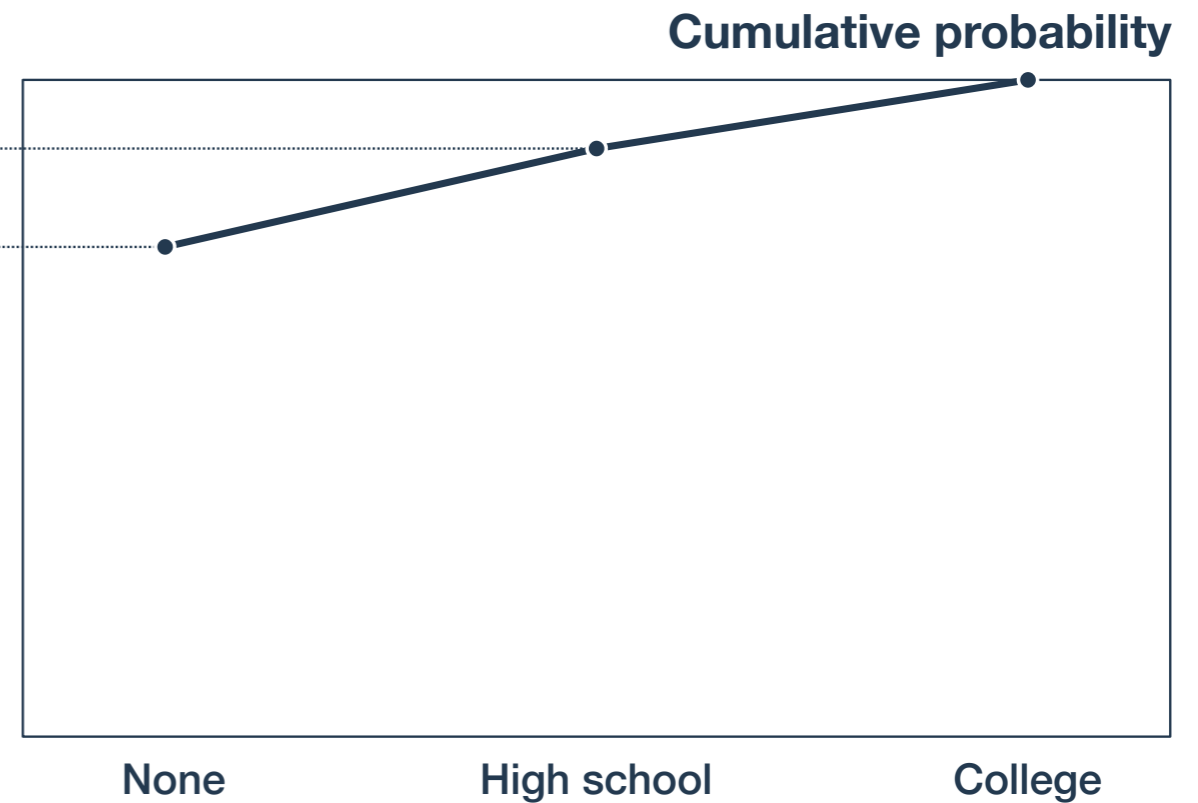
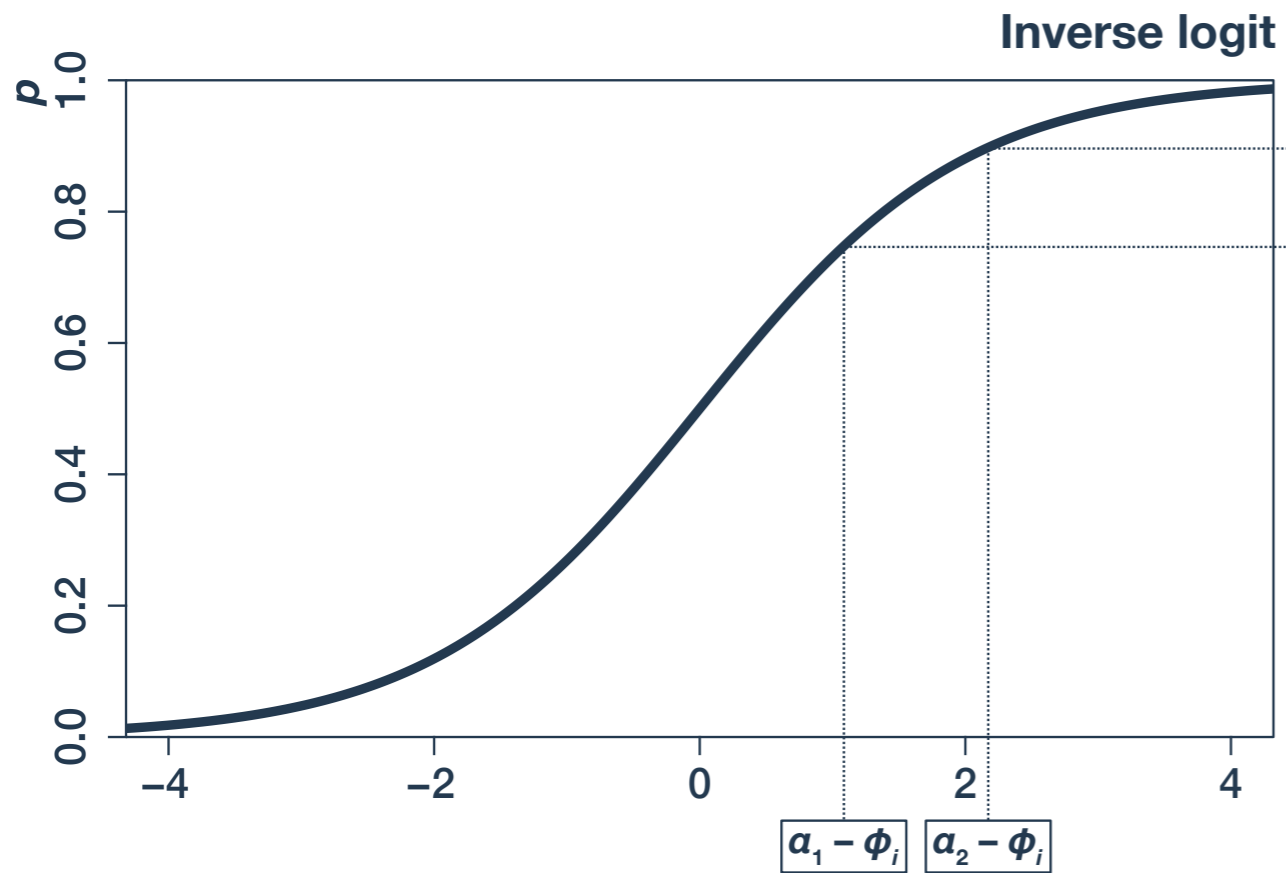
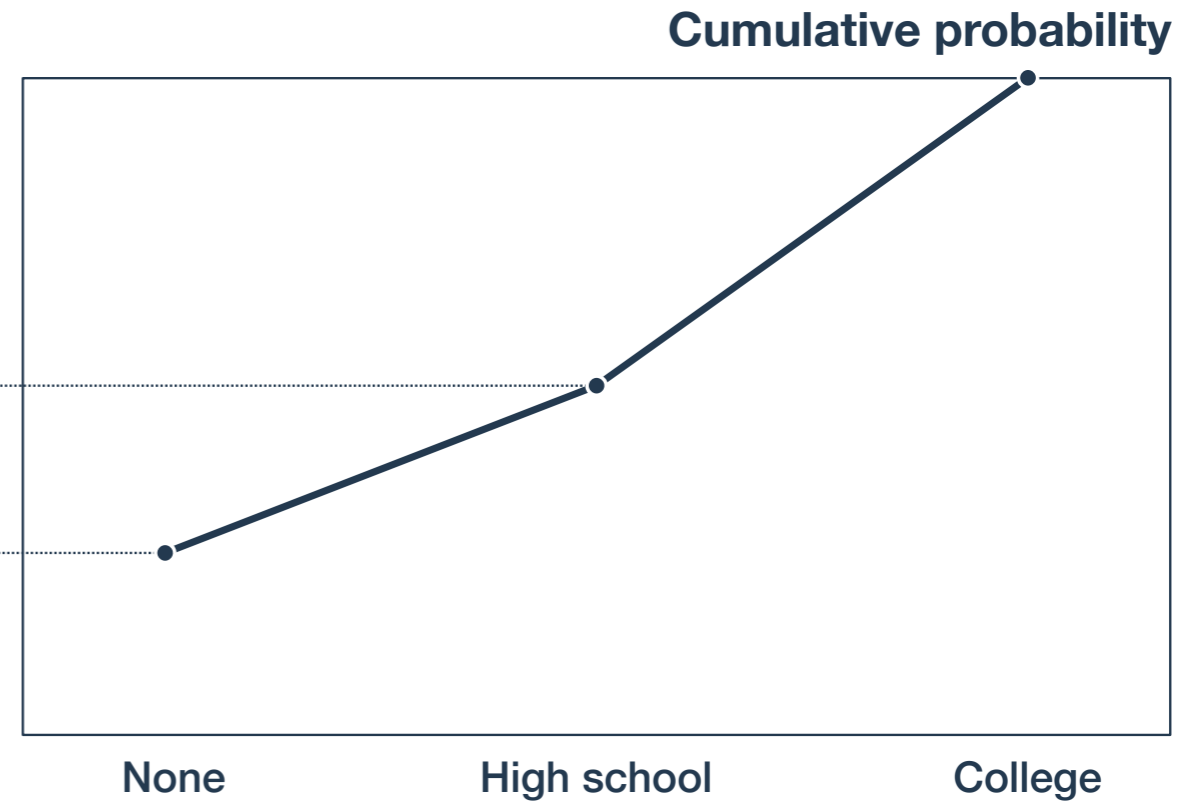
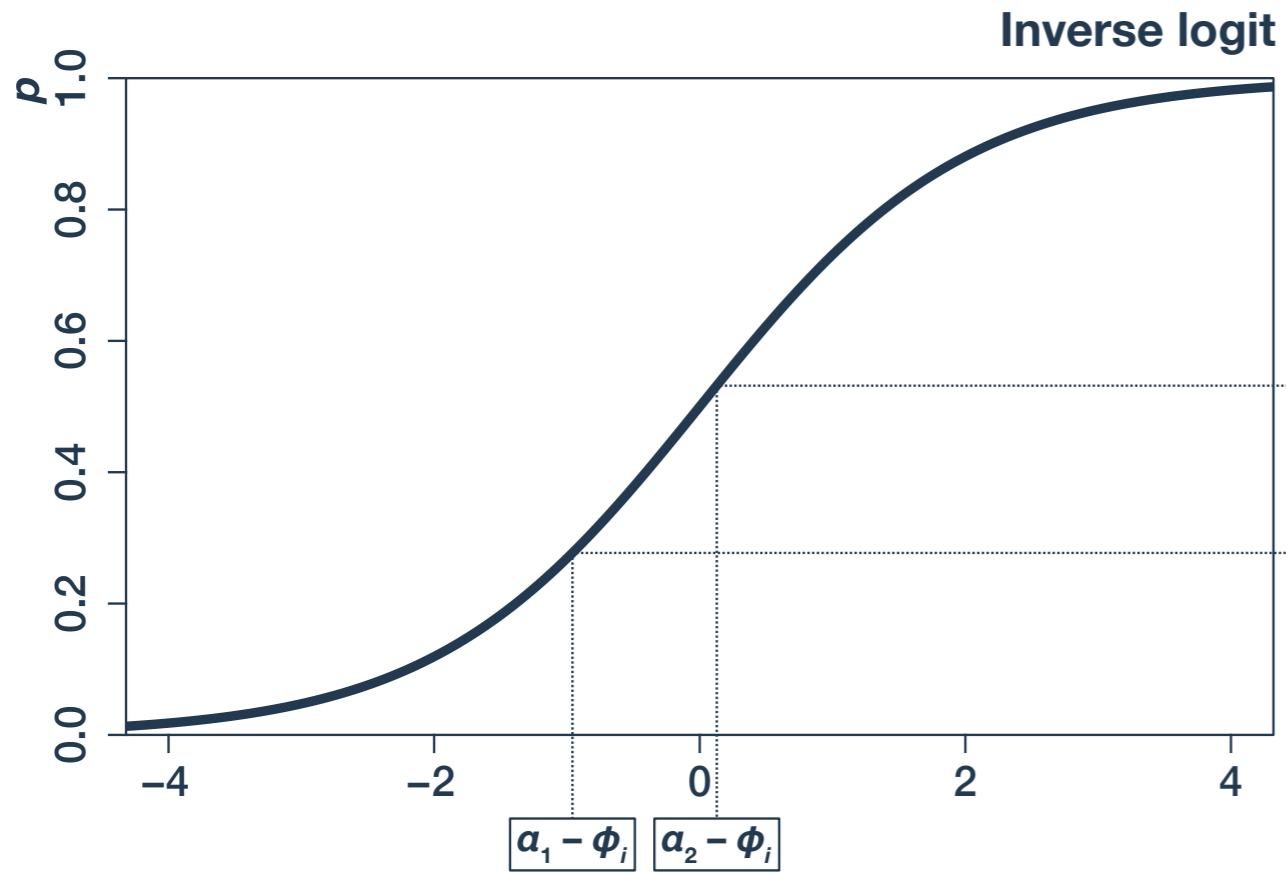
$$\phi_i = \beta H_i$$

$$a_k \sim \text{Norm}(0, 1.5)$$

$$\beta \sim \text{Norm}(0, 2)$$



Ordered logit model



Ordered logit model

