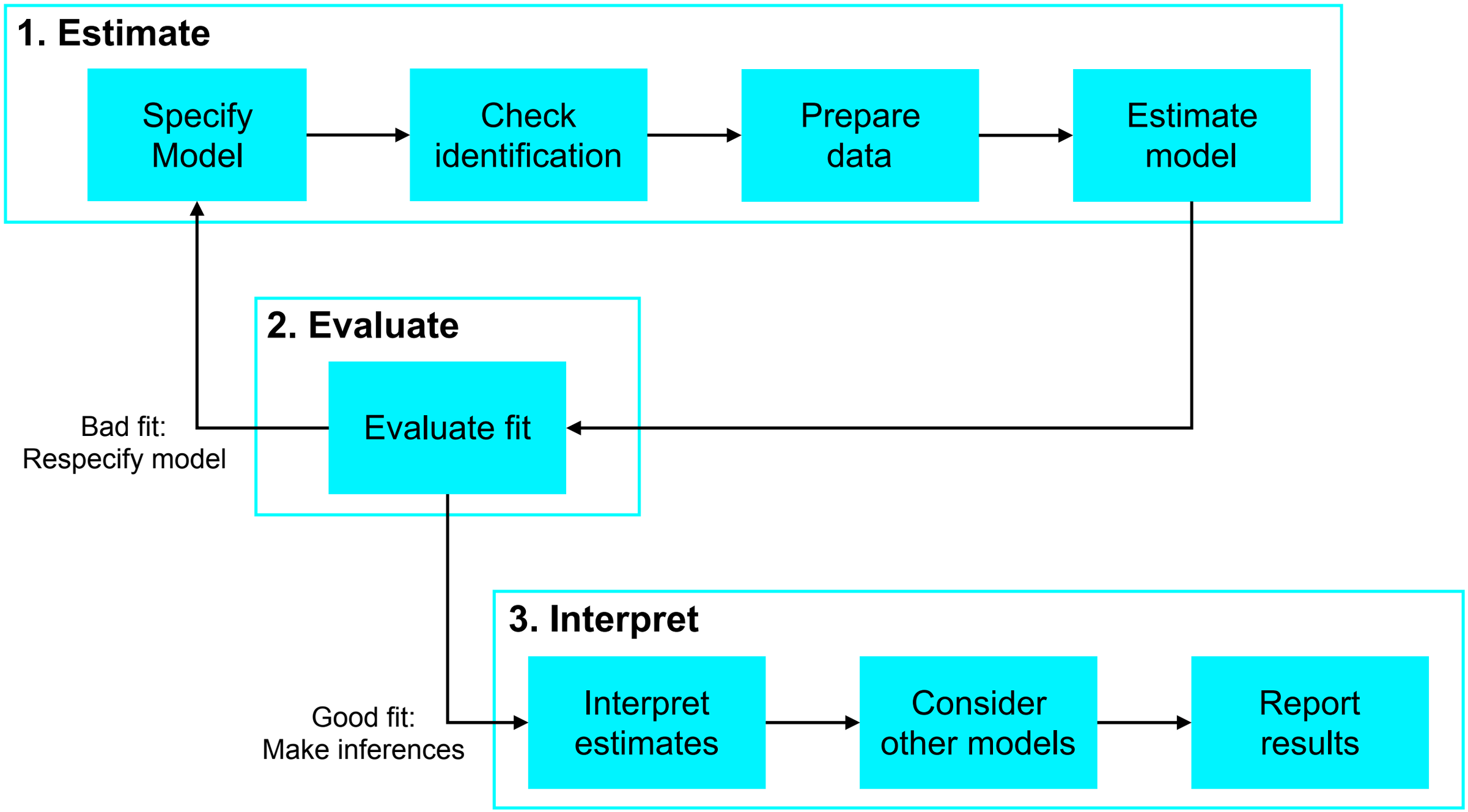
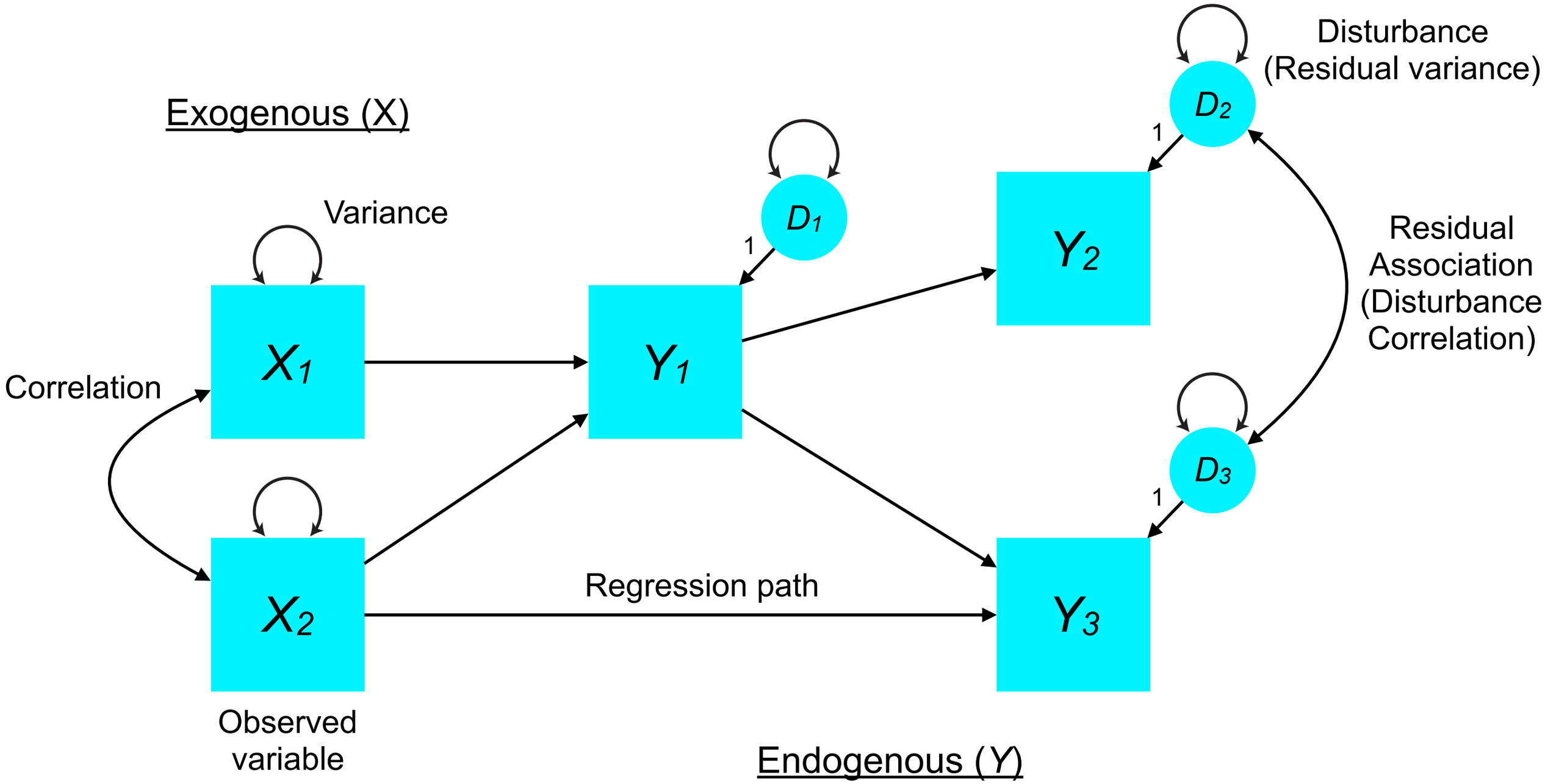
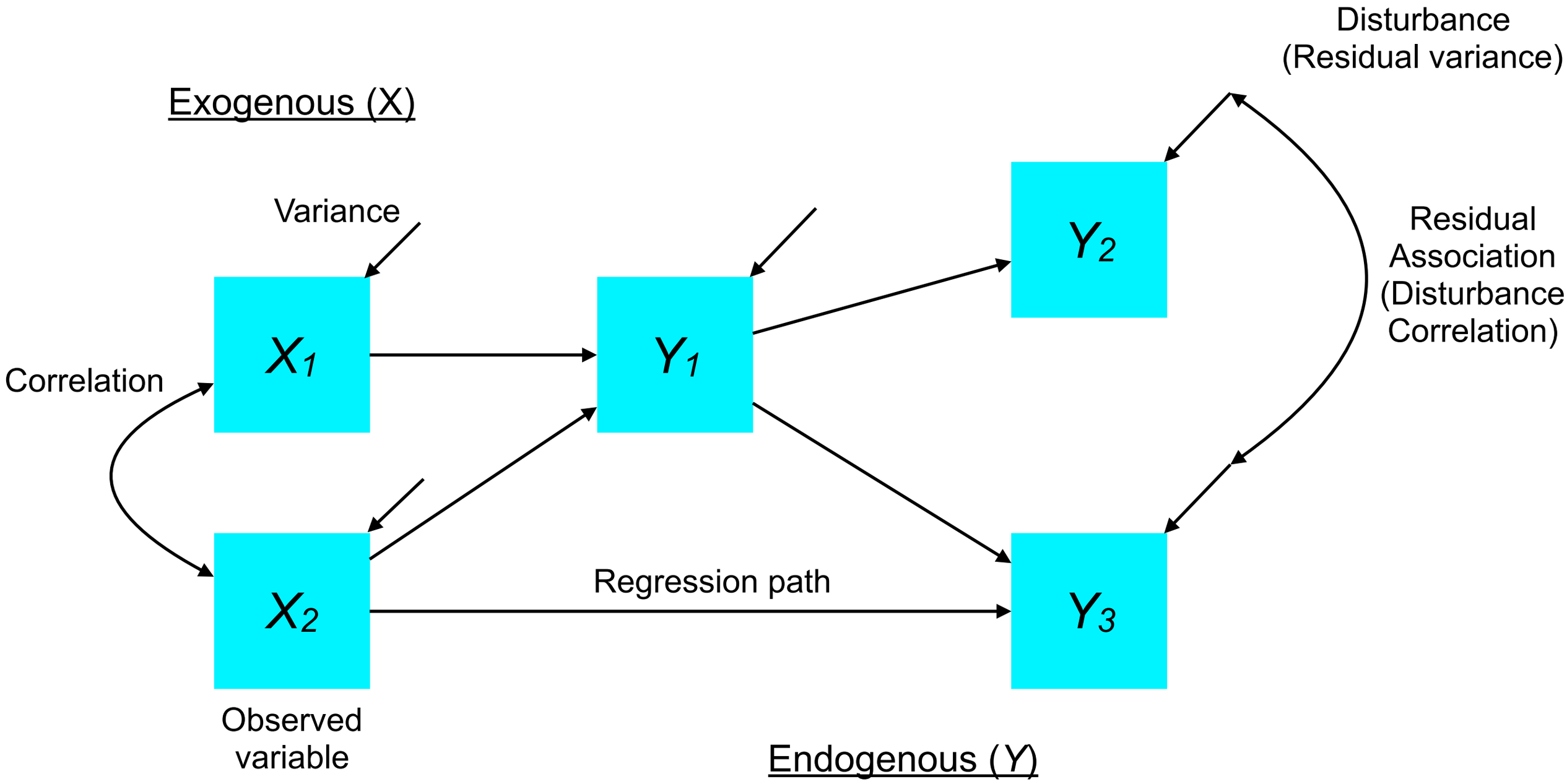
The process of fitting structural equation models



SEM notation redux (RAM notation)

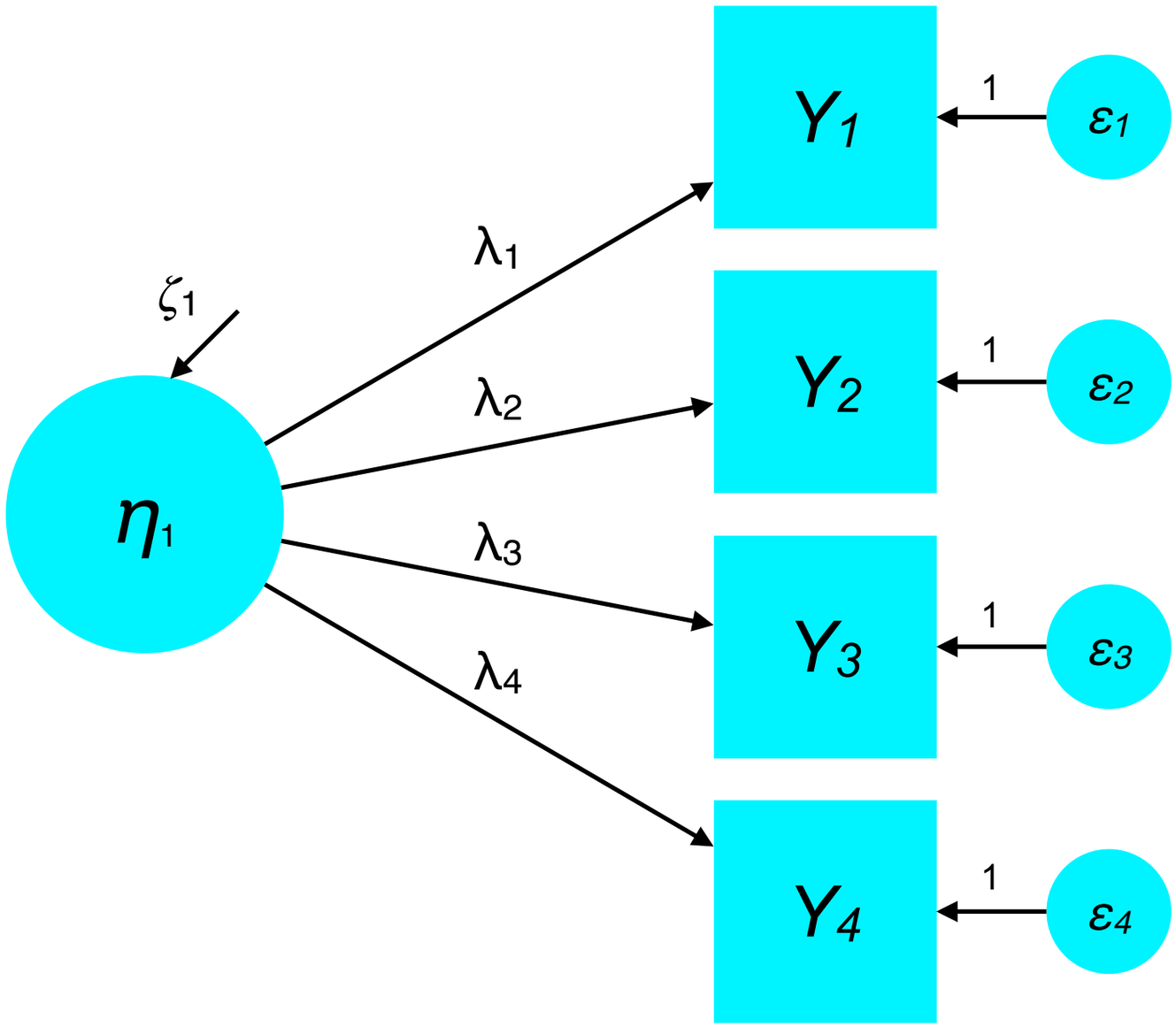


SEM notation redux (simplified RAM notation)

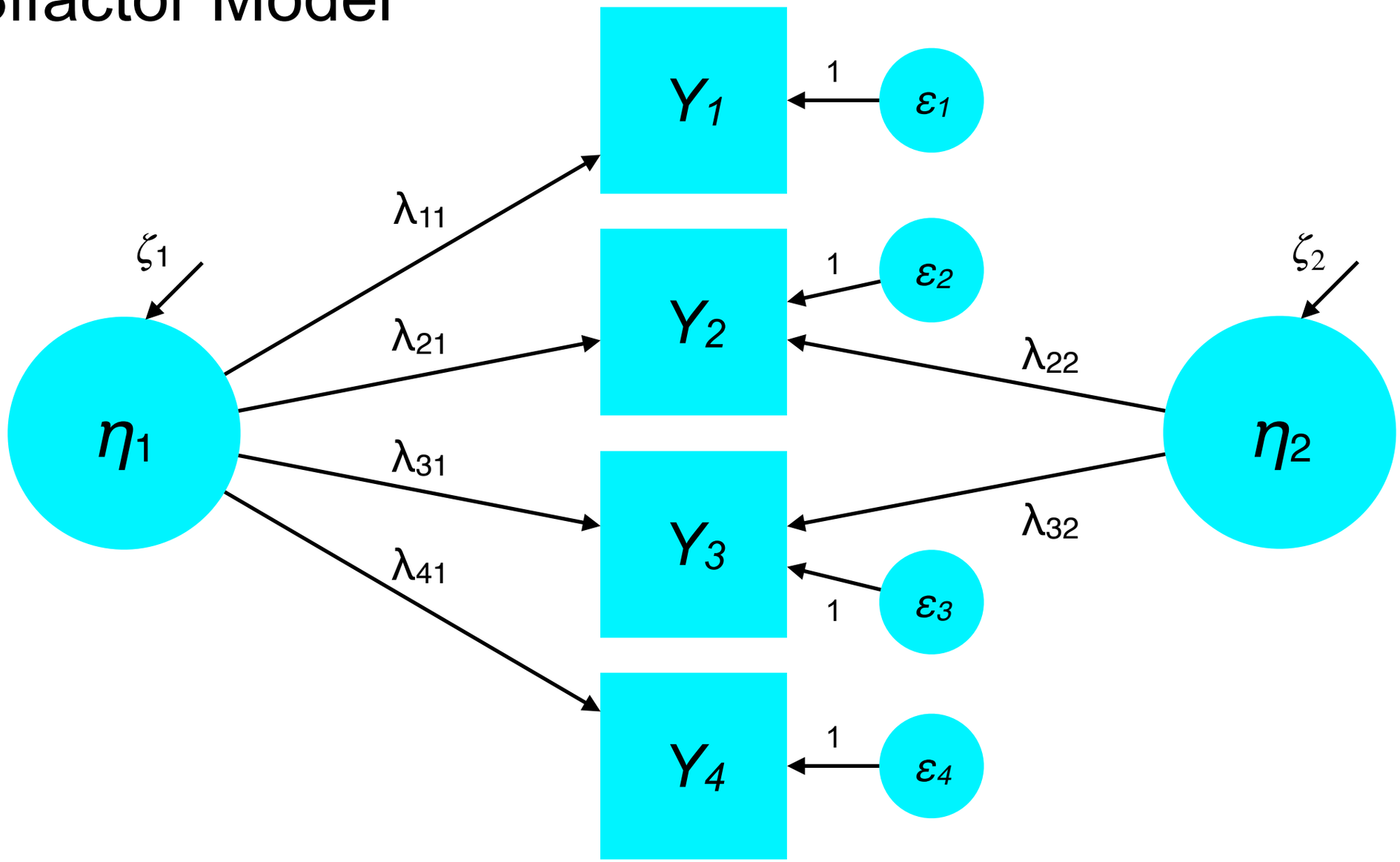


Common Factor Model

$$y_1 = \alpha_1 + \lambda_1\eta_1 + \varepsilon_1$$
$$y_2 = \alpha_2 + \lambda_2\eta_1 + \varepsilon_2$$
$$y_3 = \alpha_3 + \lambda_3\eta_1 + \varepsilon_3$$
$$y_4 = \alpha_4 + \lambda_4\eta_1 + \varepsilon_4$$



Bifactor Model



$$y_1 = \alpha_1 + \lambda_{11}\eta_1 + \varepsilon_1$$

$$y_2 = \alpha_2 + \lambda_{21}\eta_1 + \lambda_{22}\eta_2 + \varepsilon_2$$

$$y_3 = \alpha_3 + \lambda_{31}\eta_1 + \lambda_{32}\eta_2 + \varepsilon_3$$

$$y_4 = \alpha_4 + \lambda_{41}\eta_1 + \varepsilon_4$$

Estimating SEMs

Specify an estimable model, code into *lavaan* syntax

↓

Software estimates plausible starting values for all parameters

↓

Software estimates model-implied covariance matrix (**Σ**) at current parameter values

↓

Compare model-implied covariance (**Σ**) to observed covariance (**S**) according to sample log-likelihood function

$$(\mathbf{Y}_i - \boldsymbol{\mu})' \boldsymbol{\Sigma}^{-1} (\mathbf{Y}_i - \boldsymbol{\mu})$$

↓

Update model parameters to reduce discrepancies (using derivative matrices)

↑ Repeat until there is minimal change in log-likelihood (e.g., 10^{-5}). This is called model convergence.