data matrix

$$\begin{pmatrix} y_1 & 0 & 1 \\ y_2 & 1 & 0 \\ y_3 & 1 & 1 \\ . & . & . \\ . & . & . \\ y_n & 0 & 1 \end{pmatrix}$$

design matrix

$$\mathbf{X} = \begin{pmatrix} 1 & 0 & 1 & \overbrace{\quad 0 \quad}^{\text{product}} \\ 1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 \\ . & . & . & . \\ . & . & .. & . \\ 1 & 0 & 1 & 0 \end{pmatrix}$$

deterministic model

$$\mu_i = \beta_0 + \beta_1 x_{1,i} + \beta_2 x_{2,i} + \beta_3 x_{1,i} x_{2,i}$$

or, equivalently

$$\begin{pmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \\ . \\ . \\ \mu_n \end{pmatrix} = \begin{pmatrix} 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 \\ . & . & . & . \\ . & . & . & . \\ 1 & 0 & 1 & 0 \end{pmatrix} \times \begin{pmatrix} \beta_0 \\ \beta_1 \\ \beta_2 \\ \beta_3 \end{pmatrix}$$

$$\boldsymbol{\mu} = \mathbf{X}\boldsymbol{\beta}$$

likelihood

$$y_i \sim [y_i | \mu_i, \sigma^2]$$

e.g.,

$$y_i \sim \text{normal}(\mu_i, \sigma^2)$$