$$X_i = \begin{bmatrix} 1 & -1 \\ 1 & 0 \\ 1 & 1 \end{bmatrix}$$

$Y \sim 1 + X$

random ~ 1

$$Y_i = X_i \underset{\sim}{\gamma} + \underset{\sim}{1} u_{0i} + \underset{\sim}{\varepsilon}_i$$

$$Var(u_{0i}) = G = [g_{00}]$$

$$Var(\underset{\sim}{\varepsilon}_i) = \sigma^2 I_{3\times 3}$$

$$Var(\underset{\sim}{Y}_i) = Var(\underset{\sim}{1} u_{0i}) + Var(\varepsilon_i)$$

$$= \underset{\sim}{1}\, g_{00}\, 1' + \sigma^2 I$$

$$= g_{00} U + \sigma^2 I \qquad U = 11'$$

$$\Sigma_i = \begin{bmatrix} \sigma^2 + g_{00} & g_{00} & g_{00} \\ & \sigma^2 + g_{00} & g_{00} \\ & & \sigma^2 + g_{00} \end{bmatrix}$$

$$\begin{matrix} \sigma_{11} & \sigma_{12} & \sigma_{13} \\ & \sigma_{22} & \sigma_{23} \\ & & \sigma_{33} \end{matrix}$$

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random slope

$$Y_i = X_i \gamma + X_i \underset{\sim}{u}_i + \varepsilon_i$$

$$\Sigma_i = X_i G X_i' + \sigma^2 I$$

$$= \begin{bmatrix} 1 & -1 \\ 1 & 0 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} g_{00} & g_{01} \\ g_{10} & g_{11} \end{bmatrix} \begin{bmatrix} 1 & 1 & 1 \\ -1 & 0 & 1 \end{bmatrix} + \sigma^2 I$$

$$\begin{bmatrix} g_{00} - 2g_{01} + g_{11} + \sigma^2 & g_{11} - g_{10} & g_{00} - g_{11} \\ & g_{00} + \sigma^2 & g_{00} + g_{10} \\ & & g_{00} + 2g_{01} + g_{11} + \sigma^2 \end{bmatrix}$$