



Simulation-CS:

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- $P = 4P_0$ features (4 modules of features)

$$\Sigma_{P \times P} = \begin{bmatrix} \Sigma^* & & \\ & \Sigma^* & \\ & & \Sigma^* \end{bmatrix}, \text{ and } \Sigma^* = \begin{bmatrix} 1 & 0.8 \\ 0.8 & 1 \end{bmatrix}$$

(1) Generate $(y_1, \dots, y_P) \sim \text{i.i.d. } N(\vec{0}, \Sigma)$

(2) for each t : (1) generate $\varepsilon_t = (\varepsilon_{t1}, \dots, \varepsilon_{tP}) \sim \text{i.i.d. } N(0, \Sigma)$

$$\text{cov}(y_i, \varepsilon_{it}) = 0$$

$$(2) \vec{X}_t = 0.8(y_{t1}, \dots, y_{tP}) + 0.6\varepsilon_t$$

function-CS? $\vec{X}_t = 0.8\vec{y}_{tP} + 0.6\varepsilon_t$

(3) Results: $\text{cov}(X_{1k}, \dots, X_{Tk}) = \begin{pmatrix} 1 & 0.8^2 & \dots & 0.8^2 \\ 0.8^2 & 1 & & \\ \vdots & & \ddots & \\ 0.8^2 & & & 1 \end{pmatrix} \rightarrow \text{CS}$

Reasons: (1) $\text{cov}(X_{11}, X_{21}) = \text{cov}(0.8y_{11} + 0.6\varepsilon_{11}, 0.8y_{21} + 0.6\varepsilon_{21})$
 $= 0.64$

$$\text{cov}(X_{11}, X_{11}) = \text{cov}(0.8y_{11} + 0.6\varepsilon_{11}, 0.8y_{11} + 0.6\varepsilon_{11})$$

$$= 0.64$$

$$(2) \text{var}(X_{11}) = \text{var}(0.8y_{11} + 0.6\varepsilon_{11}, 0.8y_{11} + 0.6\varepsilon_{11})$$

$$= 0.8^2 + 0.6^2 = 1.$$

$$(3) \text{cov}(X_{21}, \dots, X_{2P}) = \text{cov}(X_2)$$

$$= \text{cov}(0.8y_1 + 0.6\varepsilon_2)$$

$$= (0.8^2 + 0.6^2) \Sigma = \Sigma.$$