12.4-5 Serial

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$Y_t = \beta_0 + \beta_1 X_t + \varepsilon_t$ where ε_t is correlated with prior ε_t

- $\varepsilon_t = \varepsilon_t + \theta \varepsilon_{t-1}$ MA(1)
- $\varepsilon_{t-1} = \varepsilon_{t-1} + \theta \varepsilon_{t-2}$ MA(q)
- $\varepsilon_t = \rho \varepsilon_{t-1} + \varepsilon_t$ AR(1)
  AR(q)

$Y_t = \beta_0 + \beta_1 X_t + \varepsilon_t$

$\varepsilon_t = Y_t - \beta_0 - \beta_1 X_t$

$Y_t = \beta_0 + \beta_1 X_t + \rho \varepsilon_{t-1} + \varepsilon_t$

$= \beta_0 + \beta_1 X_t + \rho (Y_{t-1} - \beta_0 - \beta_1 X_{t-1}) + \varepsilon_t$

$= (1-\rho)\beta_0 + \beta_1 X_t - \rho \beta_1 X_{t-1} + \rho Y_{t-1} + \varepsilon_t$

$Y_t = \beta_0 + \beta_1 X_t + \beta_2 Y_{t-1} + \varepsilon_t$

↳ $\varepsilon_t = \rho \varepsilon_{t-1} + \rho_2 \varepsilon_{t-2} + \varepsilon_t$

$Y_t = \beta_0 + \beta_1 X_t + \beta_2 Y_{t-1}$
$+ \rho_1 (Y_{t-1} - \beta_0 - \beta_1 X_{t-1} - \beta_2 Y_{t-2})$
$+ \rho_2 (Y_{t-2} - \beta_0 - \beta_1 X_{t-2} - \beta_2 Y_{t-3})$

$\Downarrow$

$Y_t = \beta_0 (1 - \rho_1 - \rho_2) + \beta_1 X_t - \rho_1 \beta_1 X_{t-1} + \varepsilon_t$