

LTI MODELS

(1) (3)

FUNDAMENTAL PREDICTION MODEL

$$\hat{y}(t|\theta) = \underbrace{H(q, \theta) G(q, \theta)}_{W_u(q, \theta)} u(t) + \underbrace{[1 - H(q, \theta)]}_{W_y(q, \theta)} y(t)$$

EXAMPLE 1

EQUATION ERROR MODEL STRUCTURE

$$y(t) + a_1 y(t-1) + \dots + a_n y(t-n) = b_1 u(t-1) + \dots + b_n u(t-n) + e(t)$$

$$A(q) = 1 + a_1 q^{-1} + \dots + a_n q^{-n}$$

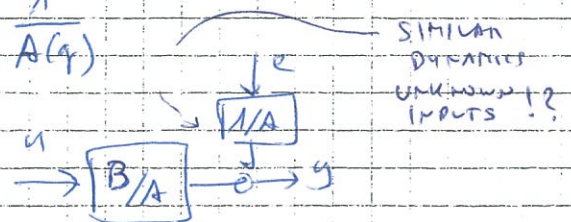
$$B(q) = 1 + b_1 q^{-1} + \dots + b_n q^{-n}$$

$$G(q, \theta) = \frac{B(q)}{A(q)} \quad H(q, \theta) = \frac{1}{A(q)}$$

ARX

AR + EXTREMAL INPUT
B(q) u(t)

PRACTICAL IMPORTANCE!



$$\hat{y}(t|\theta) = B(q) u(t) + [1 - A(q)] y(t)$$

REGRESSOR: $\underline{\phi}(t) = [-y(t-1) \dots -y(t-n) \quad u(t-1) \dots u(t-n)]^T$

$$\hat{y}(t|\theta) = \underline{\theta}^T \underline{\phi}(t) = \underline{\phi}^T(t) \underline{\theta}$$

LINEAR REGRESSION

CONVEX PROBLEM, LS
UNIQUE SOLUTION (GLOBAL)
CLOSE FORM SOLUTION