FIR :

$$y(t) = b_1 u(t-1) + b_2 u(t-2) + \dots + b_{n_b} u(t-n_b) + e(t)$$

(using $B(q^{-1}) = b_1 q^{-1} + b_2 q^{-2} + \dots + b_{n_b} q^{-n_b}$, $q^{-1} u(t) = u(t-1)$)

$B(q,\theta) \leftarrow$

$$y(t) = b_1 q^{-1} u(t) + b_2 q^{-2} u(t) + \dots + b_{n_b} q^{-n_b} u(t) + e(t)$$

$$\boxed{y(t) = B(q,\theta) \cdot u(t) + e(t)}$$

$$\hat{y}(t) = \hat{y}(t|t-1,\theta) = b_1 u(t-1) + \dots + b_{n_b} u(t-n_b)$$

$$\theta = [b_1, b_2 \dots b_{n_b}]^T$$

$$\varphi(t) = [u(t-1), u(t-2), \dots u(t-n)]^T$$

$$y(t) = \theta^T \varphi(t) + e(t)$$

$$\hat{y}(t|t-1,\theta) = \theta^T \varphi(t)$$

$$\hat{y}(t|t-1,\theta) = B(q,\theta) u(t)$$

$$y(t) = \sum_{i=1}^{n_b} b_i u(t-i) + e(t) = \theta^T \varphi(t) + e(t)$$

$$= \sum_{i=1}^{n_b} b_i q^{-i} u(t) + e(t)$$