

Assignment 10

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Problem Statement

(Papoulis chap-15- 15.9) One step predictor $\hat{s}_1[n]$ of an AR process of order m in terms of its entire past equals

$$\hat{E}[s[n]|s[n-k], k \geq 1] = - \sum_{k=1}^m a_k s[n-k]$$

Show that its two step predictor $\hat{s}_2[n]$

$$\hat{E}[s[n]|s[n-k], k \geq 2] = -a_1 s_1[n-1] - \sum_{k=1}^m a_k s[n-k]$$

Solution

As we know, if

$$s[n] = a_1 s[n-1] + \dots + a_m s[n-m] + \epsilon[n] \quad (1)$$

where

$$\epsilon[n]$$

is white noise, then the one-step predictor of $s[n]$ equals

$$s_1[n] = a_1 s[n-1] + \dots + a_m s[n-m] \quad (2)$$

is its two step-predictor. It suffices to show that

$$s[n] = \hat{s}_2[n] \perp s[n-k]$$

for $k \geq 2$

$$s[n] - \hat{s}_2[n] = a_1 \{s_1[n-1] - \hat{s}_1[n-1]\} + \epsilon[n] \quad (3)$$

So,

$$s_1[n-1] = \hat{s}_1[n-1] \perp s[n-k],$$

$$k \geq 2 \quad \text{and} \quad \epsilon[n] \perp s[n-k] \quad \text{for} \quad k \geq 1$$