SE Course: Stochastic Analysis for Engineers

http://www.cs.aue.auc.dk/~yang/course/stoc04.htm
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MM2: Discrete Linear Process Models

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1 Reading

Chapt 5, pp.250-275 of K. Sam Shanmugan and Arthur M. Breipohl: "Random Signals - Detection, Estimation and Data Analysis ", John Wiley Sons, Inc., 1988.

2 Content

- Moving Average (MA) models;
- Autoregressive (AR) models;
- Autoregressive Moving Average (ARMA) models.

3 Exercise

1. (Problem 4.14 in Textbook, page 246.)
   Assume the input to a LTI system is a zero-mean Gaussian random process with property:

   $$S_{XX}(f) = \eta/2$$

   and the impulse response of the considered system is

   $$h(t) = \begin{cases} exp(-t), & t \geq 0 \\ 0, & others \end{cases}$$

   (a) Find $S_{YY}(f)$, where $Y(t)$ is the output;
   (b) Find $E\{Y^2(t)\}$.

2. (Problem 5.3, 5.4 in Textbook, page 333.)
   An AR process $Y(n)$ is expressed as

   $$Y(n) = \frac{1}{2}Y(n-1) + Z(n), \quad n = 1, 2, \cdots$$

   where $Z(n)$ is a stationary white Gaussian noise with zero mean and $\delta_Z^2 = 1$. $Y(0)$ is a Gaussian random variable and independent of $Z(n)$.

   (a) Find the mean and variance of $Y(0)$ in order for the process to be stationary;
   (b) Assume the process is stationary, find, for the sequence $Y(n)$, (i) μ_Y; (ii) δ_Y^2; (iii) $R_{YY}(k)$; (iv) $r_{YY}(k)$; (v) $S_{YY}(f)$.

3. Prepare your self-study materials and presentation.