Stationarity and Linear filters

Quiz, 6 questions

1
point

1.
Does any stochastic process with the covariance function $K(t,s) = sin(\lambda(t-s))$ exist?

- ( ) Yes
- (x) No

1
point

2.
Let Y_n be a stochastic process which is defined as follows:

$Y_{n+1} = \alpha Y_n + X_n, n = 0, 1, ...$ Assume $Y_0 = 0$, $|\alpha| < 1$ and X_n is a sequence of i.i.d. standard normal random random variables for $n = 0, 1, 2, ...$ Decide whether Y_n is stationary and find its mean and variance:

- [ ] none of above
- [ ] Y_n is stationary, $\mathbb{E}Y_n = 0$, $VarY_n = \alpha^2 + 1$
- [ ] Y_n is non-stationary, $\mathbb{E}Y_n = 0$, $VarY_n = \dfrac{1}{1-\alpha^2}$
- [ ] Y_n is non-stationary, $\mathbb{E}Y_n = 0$, $VarY_n = \alpha^2 + 1 + 2K(Y_n, X_n)$
- [x] Y_n is stationary, $\mathbb{E}Y_n = 0$, $VarY_n = \dfrac{1}{1-\alpha^2}$

1
point

3.
Let W_t be a Brownian Motion. Is $X_t = (1-t)W_{t/(1-t)}$ a stationary process?

- [ ] X_t is strictly stationary process
- [x] X_t is weakly stationary process
- [ ] none of above

1
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4.
Let W_t be a Brownian Motion and $h > 0$ is a fixed number. Find a covariance function of a process $X_t = W_{t+h} - W_t$:

- [x] $K(t,s) = \begin{cases} h - |t-s|, & if |t-s| \le h \\ 0, & if |t-s| > h \end{cases}$
- [ ] $K(t,s) = \begin{cases} min(t,s), & if |t-s| \le h \\ 0, & if |t-s| > h \end{cases}$
- [ ] none of above
- [ ] $K(t,s) = 0 \, \forall t, s$

1
point

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5.
Let X_t is a process with independent and stationary increments. Moreover, $\mathbb{E}X_t = 0$ and $\mathbb{E}X_t^2 < \infty$. Is $Y_t = X_{t+h} - X_t$ is a wide-sense stationary process $\forall h > 0$?

- Yes
- No
- Additional information on X_t is required

1
point

6.
Let X_t be a wide-sense stationary process with autocovariance function γ, which equals to $\gamma(0) = 2$, $\gamma(1) = \gamma(-1) = 1$ and $\gamma(n) = 0$ for all other n. Find a spectral density $g_X(u)$ of this process:

- $g_X(u) = \frac{1 + cosu}{\pi}$
- None of above
- $g_X(u) = \frac{1 + 2cosu}{\pi}$
- $g_X(u) = \frac{1 + 2cosu}{2\pi}$
- $g_X(u) = \frac{1 + cosu}{2\pi}$

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