MATLAB exercise

Estimation of a random process with an FIR filter.

**Part 1:** Pencil and paper. Consider the following system:

d[n]

s[n] r[n] s\_hat[n]

c[n]

h[n]

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We wish to design a filter h[n] to estimate s[n] from r[n] such that s\_hat[n] is an MMSE estimate.

Assume that s[n] is an i.i.d processes which takes value +/-1 with equal probability for each sample. d[n] is a white, Gaussian noise process with variance s2 . c[n] is an FIR filter with impulse response of [1 .2 .4].

Find an expression for Rsr[n] and Rrr[n]. Rsr[n] is the cross-correlation of the observations R[n] an Rrr[n] is the auto-correlation of the observations.

Set up and solve the normal equations (9.55 or 11.11 from the MIT notes) for N = 4. (Note that N is the length of the FIR filter h[n], not c[n]

**Part 2:** MATLAB

MMSE estimation: Simulate the system for filters of length N = 4, 6 and 10. Report the MSE of your results in a table.