We can relate P_D to P_{FA} as follows:

$$P_D = Q\left(\frac{\sqrt{\sigma^2/N}Q^{-1}\left(P_{FA}\right) - A}{\sqrt{\sigma^2/N}}\right) = Q\left(Q^{-1}\left(P_{FA}\right) - \sqrt{\frac{NA^2}{\sigma^2}}\right)$$

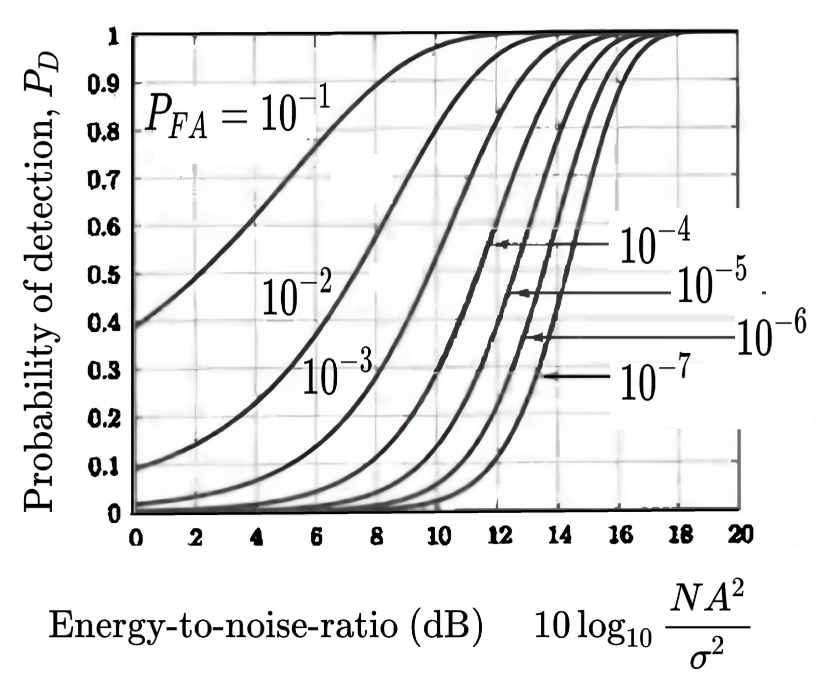

Figure 1: Detection performance for DC level in WGN.

It is seen that for a given P_{FA} the detection performance increases monotonically with NA^2/σ^2, which is the signal energy-to-noise ratio (ENR). The detection performance is shown in Figure 1 for various values of P_{FA}.

Task 1: Write a computer code to obtain the plot shown above.

Task 2: Consider the detection of a DC voltage in a white Gaussian noise scenario. Assume that we wish to have $P_{FA} = 10^{-4}$ and $P_D = 0.99$. If the signal-to-noise ratio is $10\log_{10}(A^2/\sigma^2) = -32$ dB, determine the necessary number of samples N.