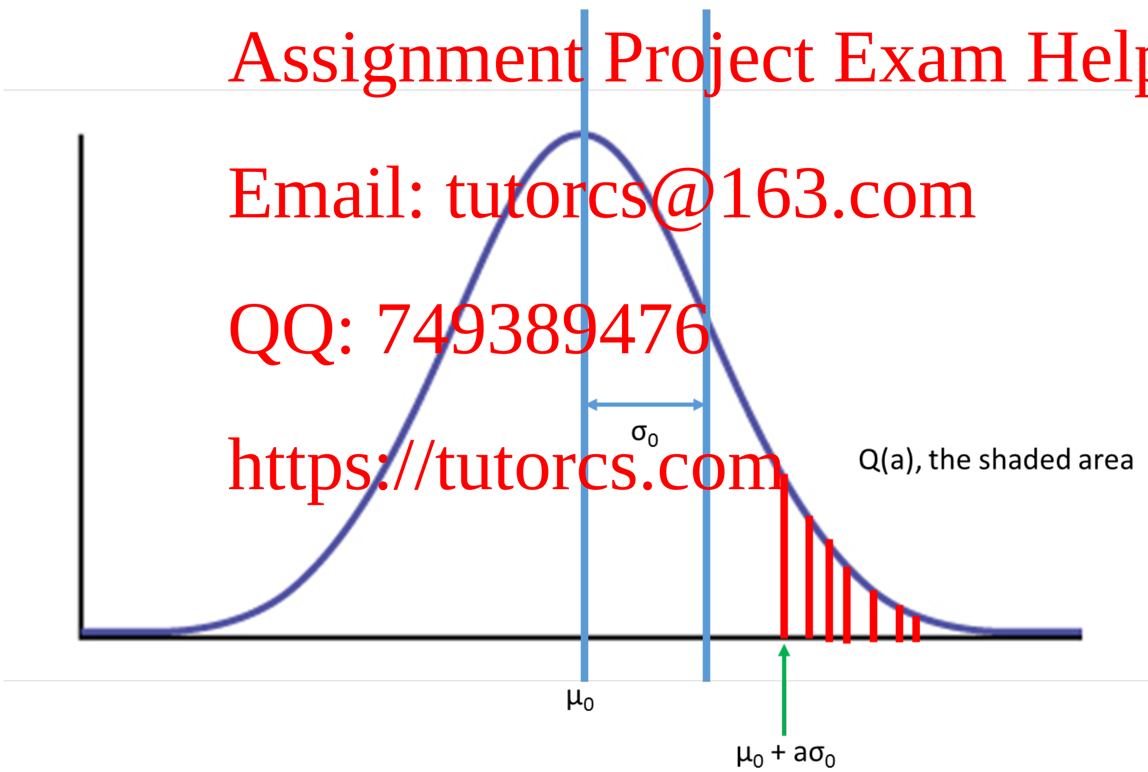
CDMA with Noise Solution

In the class, we have considered CDMA in an ideal system. However, in reality, we have much more complicated scenario: Users will experience noise.

Consider the scenari he receiver. The chipping sequence is (-1 -1 -1 +1 -1 +1 +1 +1). Suppose the se the signal sent will be (-1 -1 -1 +1 -1 +1 +1 +1). In the channel, noise is ad the received signal will be ($-1+n_1$ $-1+n_2$ $-1+n_3$ $+1+n_4$ $-1+n_5$ $+1+n_6$ $+1+n_7$ $+1+n_8$) se terms. They are independently normally distributed with zero mean and σ^2 va $\sigma^2 = 1$. Formally, $n_i \sim N(0, 1)$. You should know the normal distribution in a pre

After the computing receiver, what "value" does the receiver derive? If the value is smaller than 0, it ise, it is decoded as 1. Use the provided table to find the probability that it is wrongly decoded as -1.

The tail probability (Q function) of a standard normal distribution is given in the attached q_function.pdf.



(1) Inner product/M: $R=1+ (-n_1- n_2 -n_3 -n_4+n_5 +n_5 +n_7 +n_8)/8$

$n_i \sim N(0, 1)$.

$-n_i \sim N(0, 1)$.

$n_i/8 \sim N(0, 1/64)$.

$-n_i/8 \sim N(0, 1/64)$.

This is because if n is a Gaussian random variable with variance σ^2 , a*n is a Ga… with variance $a^2\sigma^2$

R~ N(1,1/8) = (μ_0, σ…

Th… two independent Gaussian random variables is still a Ga… See htt…ki/Sum_of_normally_distributed_random_variables

$$\ldots(\mu_X, \sigma_X^2)$$
$$Y \sim N(\mu_Y, \sigma_Y^2)$$
$$Z = X + Y,$$

then

$$Z \sim N(\mu_X + \mu_Y, \sigma_X^2 + \sigma_Y^2).$$

$P(R<0)=Q(\frac{|0-\mu 0|}{\sigma 0})=Q(2.82)\approx 2.4011*10^{-03}$

It follows the definition of Q function, see https://en.wikipedia.org/wiki/Q-function

If Y is a Gaussian random variable with mean μ and variance σ^2, then $X = \frac{Y-\mu}{\sigma}$ is standard normal

and

$$P(Y > y) = P(X > x) = Q(x)$$

where $x = \frac{y-\mu}{\sigma}$.