Estimation Theory

Problem 1) Plot the $g(x)$ function for $-3 \leq x \leq 13$.

$$\mathrm{g(x)} = \exp\left[-\frac{1}{2}x^2\right] + 0.1\exp\left[-\frac{1}{2}(x-10)^2\right]$$

Determine the maximum of the function from the plot. Using ***Newton-Raphson*** method determine the maximum of the function once for initial guess $x_0 = 0.5$ and once for $x_0 = 9.5$. (This problem can demonstrate if the initial guess isn't in the vicinity of the maximum, the algorithm falls short)

Problem 2) Create the deterministic signal $x(n)$ and using ***Maximum Likelihood*** estimator ***EM method***, determine the unknown frequencies.

Hint: First create the signals and add noise, then estimate the frequencies

$$x(n) = \sum \cos(2\pi f_i n)_{i=0}^{3} + \omega(n)\; n = 0.1 \ldots N-1$$

$$\mathbf{f} = [5, 10, 15, 20]^T$$

$$\omega \sim \mathcal{N}(0,1)$$

Problem 3) Using Least Square Estimator, estimate the unknown deterministic parameters of the following signal, $s(n)$.

$$s(n) = A_1\cos(15.9\pi n) + A_2\sin(6.3\pi n) + \omega(n)$$

$$A_1 = 3, A_2 = 2, \omega \sim \mathcal{N}(0,9)$$

Hint: First create the signals and add noise, then estimate the parameters $A_1\ and\ A_2$