Project Report

1. Task 3 - Maximum Likelihood In this task, we will use probability distribution. we shall assume a Gaussian distribution with a mean equal to the value y(x,w). We can also use maximum likelihood to determine the precision parameter Îš of the Gaussian conditional distribution. Maximizing above equation with respect to Îš gives:

2. $$lnp(t|x,w,\beta) = \left(\frac{\beta}{2}\right)\sum(y(\mathbf{x_n}) - \mathbf{t_n})^2 + \left(\frac{N}{2}\right)ln\beta - \left(\frac{N}{2}\right)ln2\pi.$$

   Differentiating with respect to w, we get

   $$\frac{d}{dw}(E(w)) = \left(\frac{1}{2}\right)(2X^TX - 2X^Tt)$$

   $$\frac{d}{dw}(E(w)) = X^TXw - X^Tt+$$

   equate this to 0:

   $$w* = (X^TX)^{-1} - X^Tt$$

   If we differentiate above equation with respect to Îš we will get:

   $$\left(\frac{1}{\beta}\right) = \left(\frac{1}{N}\right)\sum(y(\mathbf{x_n}) - \mathbf{t_n})^2.$$

   Having determined the parameters w and Îš, we can now make predictions for new values of x. We will see below the width of shaded region varies for different values of M.

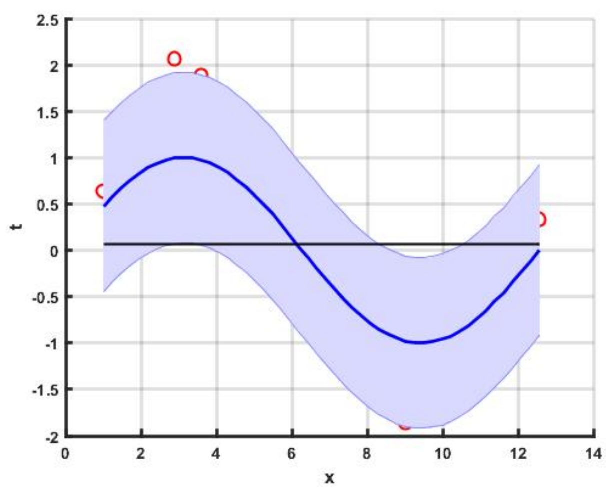

Figure 1: Case 1: (M = 0) w* = [-0.0501]

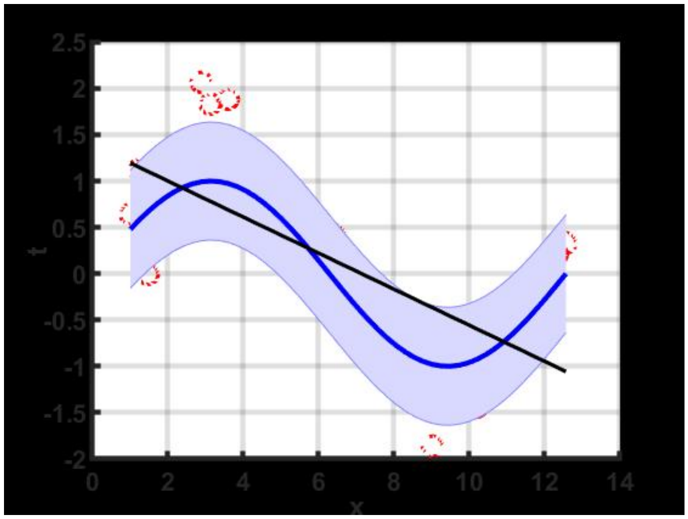

Figure 2: Case 2: (M = 1) w* =[1.2014, -0.1848]

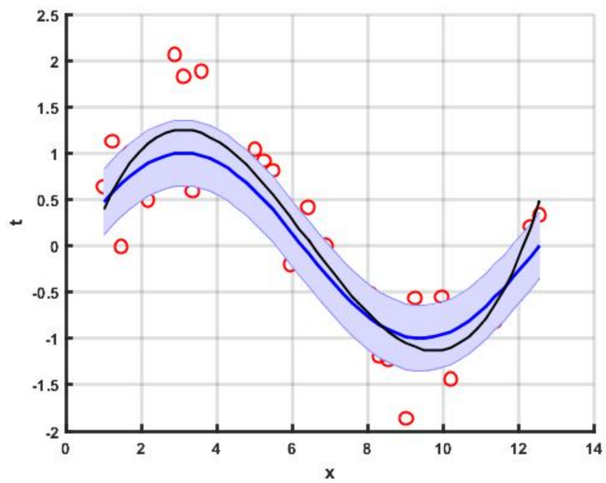

Figure 3: Case 3: (M = 3) w* =[0.1922, 0.7061,-0.1813, 0.0099]

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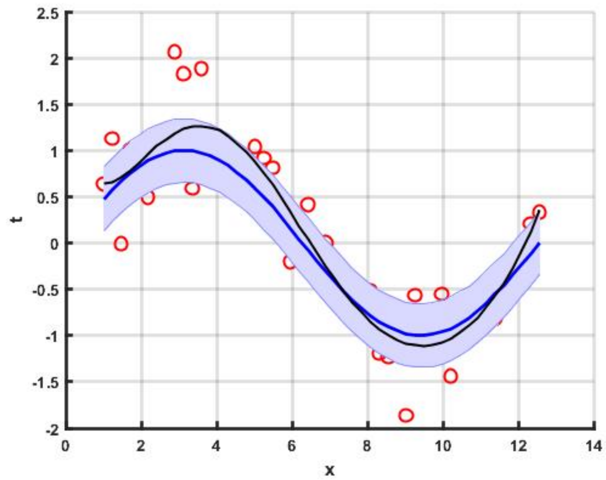

Figure 4: Case 4: (M = 6) w* = [-0.3129, 1.6050,-0.7302, 0.1619,-0.0209, 0.0014,-0.0000]

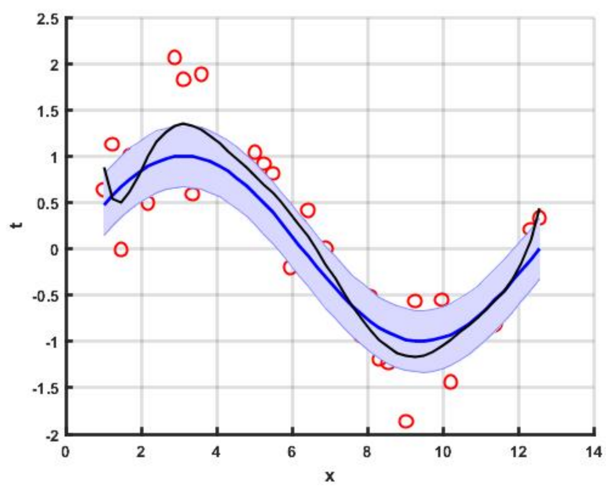

Figure 5: Case 5: (M = 9) w* = [-9.4270, 25.7526,-25.9357, 13.8811, -4.3654, 0.8423, -0.1007, 0.0073, -0.0003, 0.0000]

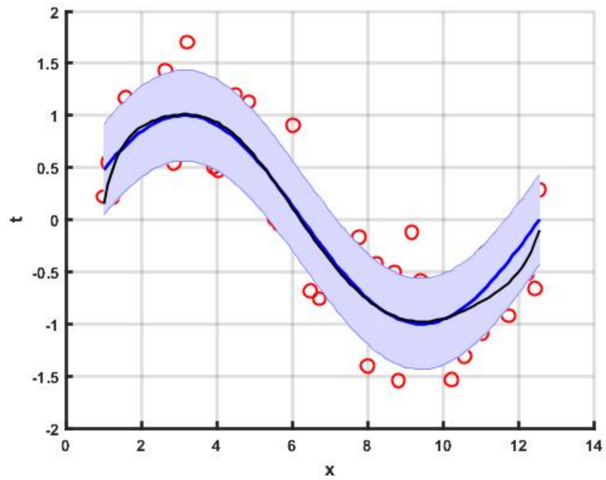

Figure 6: Case 6: (N=100)

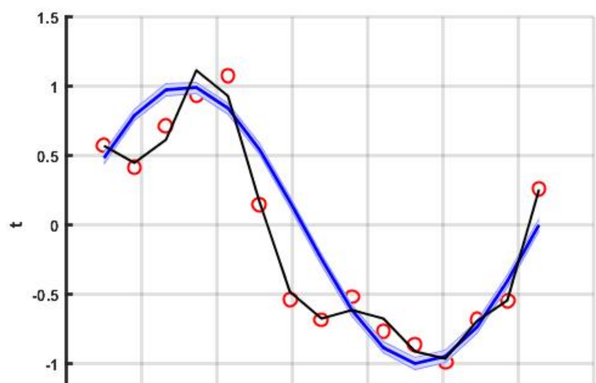

Figure 7: Case 7: (N=15, We can see, for N = 15 we have very little precision. this is because M and N are almost same so curve is trying to over-fit)