Project Report

1. Task 1 - Energy Minimization

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

Differentiating with respect to w, we get

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

$$\frac{d}{dw}\left(E(w)\right) = X^T X w - X^T t$$

equate this to 0:

$$w* = (X^T X)^{-1} - X^T t$$

In this task, we have to minimize the error given by the above equation. For this we perform differentiation and get values of all w coefficients.

For fixed Number of sample points: N =50 We see that curve is most accurate for M=3 and becomes less accurate as M increases

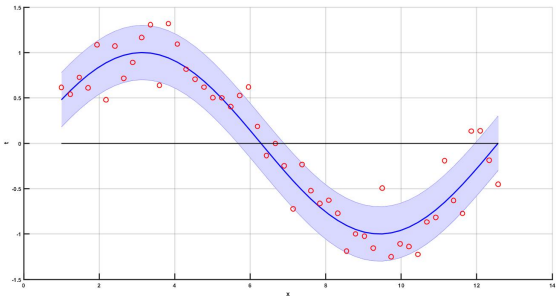

Figure 1: Case 1: (M = 0) w* = [-6.2256e-04]

2.

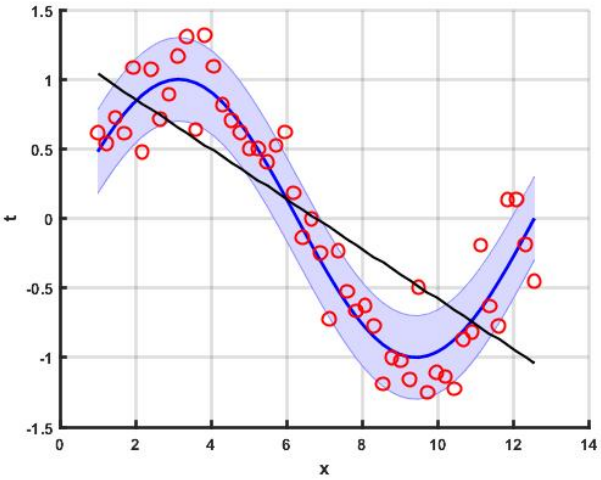

Figure 2: Case 2: (M = 1) w* = [1.2167,-0.1795]

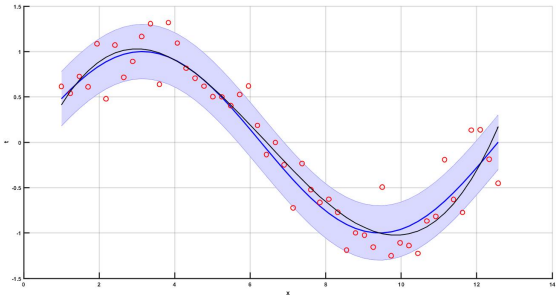

Figure 3: Case 3: (M = 3) w* = [-0.4726, 1.1171, -0.2435, 0.0126]

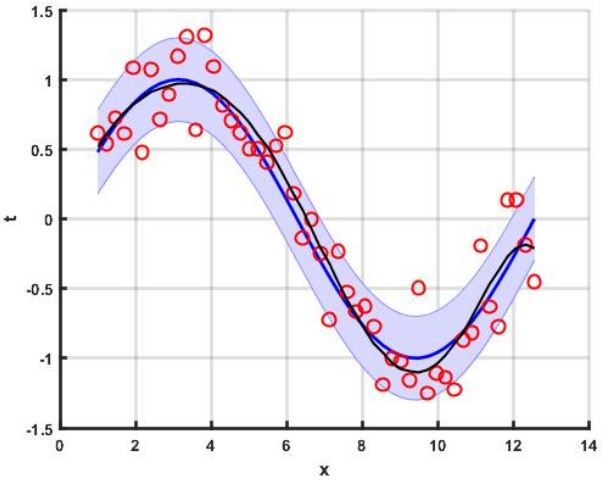

Figure 4: Case 4: (M = 6) w* = [-0.1706, 0.9951,-0.4037, 0.1121,-0.0199, 0.0017,-0.0000]

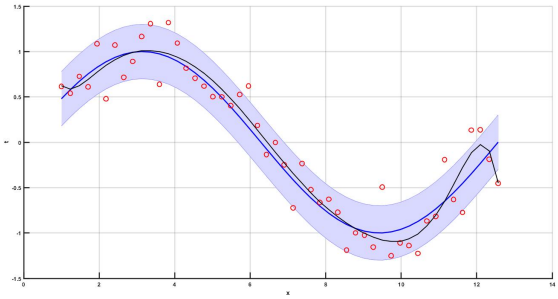

Figure 5: Case 5: (M = 9) w* = [3.5588,-7.4393, 7.1931,-3.5730, 1.0628,-0.2002, 0.0239,-0.0018, 0.0001,-0.0000]

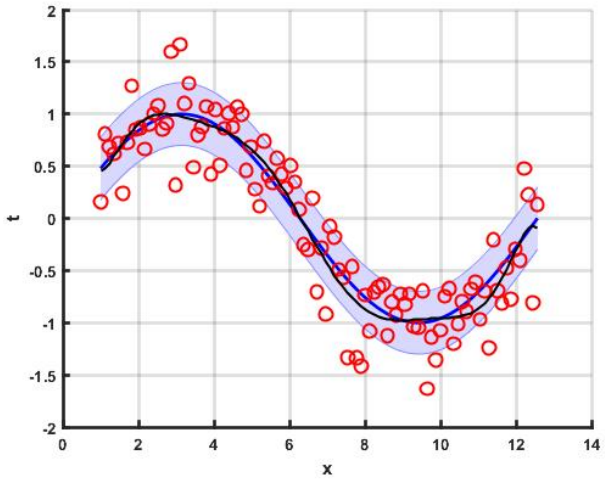

Figure 6: Case 1: (M = 9) N=100 -> For fixed value of M=9

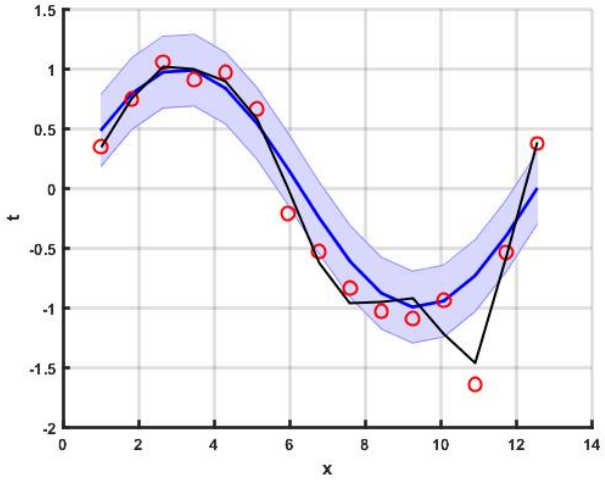

Figure 7: Case 2: (M = 9) N=100 -> For fixed value of M=9 the curve is trying to overfit