1. load data1.mat. It contains 10 samples with input x and target value t, where variable xi and ti are both vectors of dimension 10×1. Consider the target t is modelled as functions of different orders of x,



where M is the order of polynomials and **w**=[w0 w1 … wM]T is the coefficient vector. To evaluate the fitting performance, define error function as



Consider the following cases, then calculate the E(***w***) using Matlab. Fill solutions in Table 1.

1) M =1, **w** = [0.9 -1.3] T y=0.9-1.3x2) M =1, **w** = [1.0 -1.6] T

3) M =2, **w** = [1.8 -7.0 4.8] T4) M =2, **w** = [2.1 -6.5 5.1] T

5) M =3, **w** = [-0.1 12 -40 30] T6) M =3, **w** = [0 15 -30 20] T

7) M =4, **w** = [-1 20 -70 78 -20] T8) M =4, **w** = [-2 22 -68 78 -25] T

9) M =9, **w** = [-30 750 -6600 30000 -80000 100000 -75000 14000 15000 -6200] T10) M =9, **w** = [-40 760 -6000 25000 -70000 110000 -80000 12000 16000 -6600] T

|  |  |  |  |
| --- | --- | --- | --- |
|  | E(***w***) | best **w\***=(XTX)-1XTt | E(***w\****) |
| 1) | 1.8191 | [0.9206  -1.5035] | 1.7602 |
| 2) | 1.7676 |
| 3) | 1.5786 | [2.0024  -6.9128  4.9175] | 1.1218 |
| 4) | 2.0576 |
| 5) | 1.3901 | [ -0.0622  11.3997  -34.7877  24.0637] | 0.2275 |
| 6) | 44.2974 |
| 7) | 36.06803 | [ -0.8424  21.4023  -71.3880  74.0765  -22.7331] | 0.1850 |
| 8) | 22.8054 |
| 9) | 5.5072e+7 | 1.0e+05 \*  [ -0.0003  0.0075  -0.0663  0.2981  -0.7502  1.0663  -0.7730  0.1393  0.1451  -0.0665] | 2.1838e-06 |
| 10) | 8.3933e+05 |

2. solve optimal w\* using the closed form solution **w\***=(XTX)-1XTt, and calculate the minimal error function E(w\*). (Compare E(w) and E(w\*))