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 … wN]T is the coefficient vector. To evaluate the fitting performance, define error function as



Use least-square method to minimize E(w), find the optimal **w\***

|  |  |  |  |
| --- | --- | --- | --- |
| M | optimal **w\*** | *E*(***w\****) | *E*RMS(***w\****) for data2.mat |
| M=1 | [0.9206  -1.5035] | 1.7602 | 0.4959 |
| M=2 | [2.0024  -6.9128  4.9175] | 1.1218 | 0.5809 |
| M=3 | [ -0.0622  11.3997  -34.7877  24.0637] | 0.2275 | 0.2011 |
| M=4 | [ -0.8424  21.4023  -71.3880  74.0765  -22.7331] | 0.1850 | 0.2647 |
| M=9 | 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 | 3.7261 |

2. load data2.mat. It contains 100 groups of input x and target value t (xi2 and ti2), which are used as test database for evaluation of the obtained model. Define root-mean-square (RMS) error as



Please fill the table with *E*RMS accordingly.

3. Least square with regularization. Define a modified error function of the form



Differentiating with respect to **w**,



where 

let , it solves that



which is the closed-form solution minimizing . Consider when M=9, fill the following table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| M | λ | optimal **w\*** |  |  | *E*RMS(***w\****) for data2.mat |
| M=9 | λ=0 | 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 | 2.1838e-06 | 3.7261 |
|  | λ=e-18 | [-1.3801  36.0304  -195.2864  484.1515  -516.7392  -59.2077  406.4690  82.7843  -368.8335  132.4245] | 0.0891 | 0.0825 | 0.3359 |
|  | λ=1 | [0.4363  -0.4982  -0.4454  -0.2573  -0.0882  0.0409  0.1350  0.2025  0.2508  0.2852] | 2.0442 | 1.5862 | 0.5370 |

Please note the *E*RMS(***w\****) for test dataset (data2.mat).