Xiaowen Mao
PID: A53220159
x9mao@eng.ucsd.edu

Nov 1

ASSIGNMENT 5

5.5 Stock market prediction

1. The linear coefficients:

$$(a_1, a_2, a_3, a_4) = (0.9452,\ 0.0197,\ -0.0136,\ 0.0468)$$

2. Mean squared prediction error:

$$SWE_{2000} = 13918.6329$$

$$SWE_{2001} = 3018.2678$$

   I wouldn't recommend this linear model for stock market prediction since the mean squared prediction error is too big.

3. Source Code as hw5_5.m

5.6 Handwritten digit classification

1. Training:

   Using gradient ascent: label $y_t = 0$ as number 3 and $y_t = 1$ as number 5.

   Evidences are following.

(a) Converged Log-likelihood

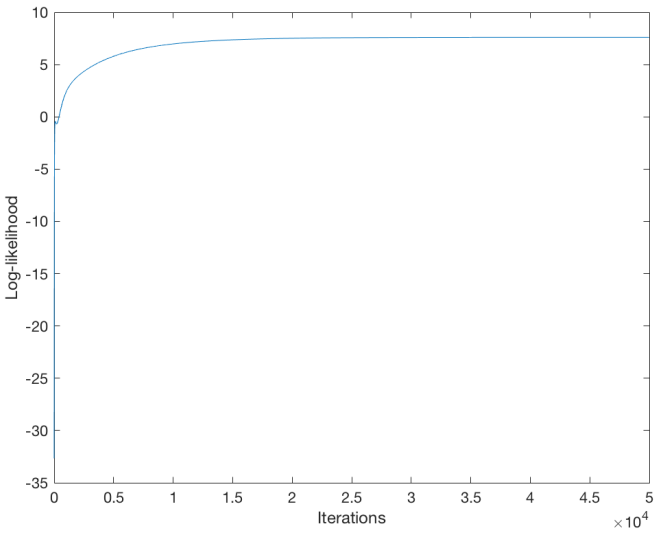

Figure 1: Converged Log-likelihood

(b) Converged Error Rate

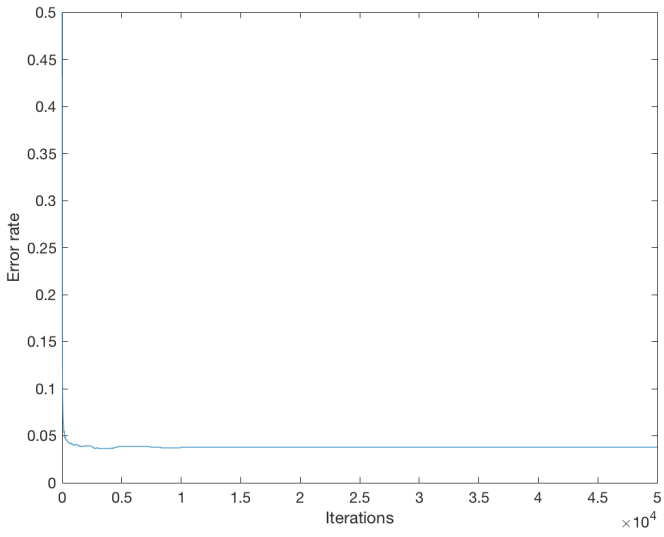

Figure 2: Converged Error Rate

(c) Weight Vector:

$$w = \begin{pmatrix} -0.6989 & -1.7908 & -1.0959 & -1.5592 & -0.6128 & -1.1959 & 0.8051 & 1.9816 \\ -0.3066 & -0.2751 & 0.3372 & -0.0348 & -0.7023 & 1.0081 & -1.5006 & -1.5139 \\ 4.5379 & 1.3988 & 1.6299 & 0.0953 & 1.0375 & -2.4793 & -2.4669 & -2.9456 \\ 0.7536 & 0.3636 & 0.7941 & -0.3658 & -0.5321 & -2.8130 & 0.5335 & -0.0648 \\ 0.6671 & 1.3347 & 0.1123 & -0.4830 & -0.6311 & -0.0300 & -0.6768 & -0.0605 \\ 1.3431 & -0.3001 & -0.4576 & -0.2282 & -0.0544 & -1.1704 & 1.0381 & -1.8978 \\ 1.7597 & -0.7811 & 1.4257 & 0.7418 & 0.5412 & -0.4761 & 0.1211 & -1.7663 \\ 0.7467 & 0.3604 & 0.7869 & 2.7175 & 0.4310 & 0.7548 & 0.9917 & -0.6337 \end{pmatrix}$$

2. Testing:

$$Error_{Three} = 7.5\%$$
$$Error_{Five} = 5.75\%$$
$$Error_{ALL} = 6.63\%$$

I think the error rate is acceptable.

3. Source Code as hw5_6.m

1 Source Code

Listing 1: hw5_5.m

```
clear all

[x_00] = textread('nasdaq00.txt', '%f');

% A 4*4
A = zeros(4,4);
for t = 5: length(x_00)
    x_t = [x_00(t-1,1); x_00(t-2,1); x_00(t-3,1); x_00(t-4,1)];
    A = A + x_t * (x_t)';
end

% b 4*1
b = zeros(4,1);
for t = 5: length(x_00)
    for i = 1:4
        b(i,1) = b(i,1) + x_00(t,1) * x_00(t-i,1);
    end
end

% Aw = b
w = A^(-1) * b;

% SWE
% 2000
SWE_00 = 0;
for t = 5:length(x_00)
    x_t = [x_00(t-1,1); x_00(t-2,1); x_00(t-3,1); x_00(t-4,1)];
    SWE_00 = SWE_00 + (x_00(t,1) - w'*x_t)^2;
end
SWE_00 = SWE_00/(length(x_00)-4);

% 2001
[x_01] = textread('nasdaq01.txt', '%f');
SWE_01 = 0;
for t = 5:length(x_01)
    x_t = [x_01(t-1,1); x_01(t-2,1); x_01(t-3,1); x_01(t-4,1)];
    SWE_01 = SWE_01 + (x_01(t,1) - w'*x_t)^2;
end
SWE_01 = SWE_01/(length(x_01)-4);
```

Listing 2: hw5_6.m

```
clear all;
```

```
2  % Gradient Ascent
3
4  %% ----- training -----
5
6  % label yt = 0 for 3
7  % label yt = 1 for 5
8  x3 = load('train3.txt');
9  x5 = load('train5.txt');
10 y3 = zeros(size(x3, 1), 1);
11 y5 = ones(size(x5, 1), 1);
12 T = [x3;x5];
13 Y = [y3;y5];
14 I = ones(size(Y));
15
16 % Config of Learning
17 iter = 50000;
18 rate = 0.02/100;
19
20 % initialize weight
21 W = rand(64, 1);
22 for i = 1:iter
23     Grad = T'*(Y - sigmoid(T*W));
24     W = W + rate*Grad;
25     err(i) = sum(Y ~= (sigmoid(T*W)>=0.5))/length(Y);
26     L(i) = Y'*log(sigmoid(T*W)) - (I-Y)'*log(sigmoid(-T*W));
27 end
28 figure(1);
29 plot(L(20:end)), xlabel('Iterations'), ylabel('Log-likelihood');
30 figure(2);
31 plot(err), xlabel('Iterations'), ylabel('Error rate');
32
33 %% ----- testing -----
34
35 t3 = load('test3.txt');
36 t5 = load('test5.txt');
37 y3 = zeros(size(t3, 1), 1);
38 y5 = ones(size(t5, 1), 1);
39 T = [t3;t5];
40 Y = [y3;y5];
41 errorAll = sum(Y ~= (sigmoid(T*W)>=0.5))/length(Y);
42 errorOn3 = sum(y3 ~= (sigmoid(t3*W)>=0.5))/length(y3);
43 errorOn5 = sum(y5 ~= (sigmoid(t5*W)>=0.5))/length(y5);
44
45 %% ----- sigmoid function -----
46 % function: sigmoid for a matrix at each [i][j]
47 function res = sigmoid(X)
```

```
48
49        I = ones(size(X));
50        E = ones(size(X))*exp(1);
51        res = I./(I+E.^(-X));
52
53  end
```

Submitted by Xiaowen Mao on Nov 1.