

# Homework 5

Motoaki Takahashi

## Question 1

The log likelihood is  $-1.2571e+03$ .

## Question 2

The log likelihood is  $-1.2571e+03$ .

## Question 3

The starting value is  $(\gamma, \beta_0, \sigma_\beta) = (0, 0.1, 1)$ . The maximizer of the log likelihood is  $(-0.5056, 2.4832, 1.4055)$ . The value of maximized log-likelihood is  $-536.2378$ .

## Question 4

The starting value is  $(\gamma, \beta_0, \sigma_\beta, u_0, \sigma_u, \rho) = (1, 1, 1, 1, 1, 0.3)$ . The maximizer of the log likelihood is  $(-0.6798, 3.1532, 1.8790, 1.4566, 1.6036, 0.4382)$ . The value of maximized log-likelihood is  $-463.3630$ .

## Code

```
% Motoaki Takahashi
% HW5 for Econ 512 Empirical Method

clear
delete HW5log.txt
diary('HW5log.txt')
diary on
load('hw5.mat')
addpath('..'/CEtools/');
X = data.X;
Y = data.Y;
Z = data.Z;
N = 100;
T = 20;

%% Q1
disp('Question 1')
par = [0, 0.1, 1];
```

```

-withoutu(X, Y, Z, par, 20, 1, N, T)

%% Q2
disp('Question 2')
-withoutu(X, Y, Z, par, 100, 2, N, T)

%% Q3
disp('Question 3')
disp('Gaussian Quadrature')
% restrict the arguments to only par
withoutu_min = @(par) withoutu(X, Y, Z, par, 20, 1, N, T);
par = ones(3,1); % When I started with pi*ones(1,3), I didn't get the result.

% minimize the log-likelihood with the restriction that the variance is
% positive

% restriction in fmincon
A = [0, 0, -1];
b = 0;

[x, fval] = fmincon(withoutu_min, par, A, b);
disp('The minimizer is')
disp('gamma beta0 sigmab')
disp(x')
disp('The value of the negative log-likelihood is')
disp(fval)

disp('Monte Carlo')
% restrict the arguments to only par
withoutu_min = @(par) withoutu(X, Y, Z, par, 100, 2, N, T);
par = ones(3,1);
[x, fval] = fmincon(withoutu_min, par, A, b);
disp('The minimizer is')
disp('gamma beta0 sigmab')
disp(x')
disp('The value of the negative log-likelihood is')
disp(fval)

%% Q4

X = data.X;
Y = data.Y;
Z = data.Z;
N = 100;
T = 20;

disp('Question 4')
% restrict the arguments to only par
withu_min = @(par) withu(X, Y, Z, par, 100, N, T);
par = [ 1;1;1;1;1;0.3 ]; %cholesky decomposition needs a pd matrix

```

```
% constraint
A = [ 0, 0, -1, 0, 0, 0;
      0, 0, 0, 0, -1, 0;
      0, 0, 0, 0, 0, 1;
      0, 0, 0, 0, 0, -1];
b = [ 0; 0; 1; 1];
[x, fval] = fmincon(withu_min, par, A, b);
disp('The minimizer is')
disp('  gamma      beta0      sigmab      u0      sigmau      rho')
disp(x')
disp('The value of the negative log-likelihood is')
disp(fval)

diary off
```

## Output

Question 1

```
ans =

-1.2571e+03
```

Question 2

```
ans =

-1.2571e+03
```

Question 3  
Gaussian Quadrature

```
<a href = "matlab: helpview([docroot '/toolbox/optim/msg_csh/optim_msg_csh.map'], 'local_min_
```

```
fmincon stopped because the <a href = "matlab: helpview([docroot '/toolbox/optim/msg_csh/optim_m
the default value of the <a href = "matlab: helpview([docroot '/toolbox/optim/msg_csh/optim_m
satisfied to within the default value of the <a href = "matlab: helpview([docroot '/toolbox/optim
```

```
<<a href = "matlab: createExitMsg('barrier',2.000000e+00,true,true,'fmincon',5.770665e-11,'defau
```

```
The minimizer is
gamma beta0 sigmab
-0.5056    2.4832    1.4055
```

```
The value of the negative log-likelihood is
536.2378
```

Monte Carlo

```
<a href = "matlab: helpview([docroot '/toolbox/optim/msg_csh/optim_msg_csh.map'], 'local_min_
```

```
fmincon stopped because the <a href = "matlab: helpview([docroot '/toolbox/optim/msg_csh/optim_m
the default value of the <a href = "matlab: helpview([docroot '/toolbox/optim/msg_csh/optim_m
```

satisfied to within the default value of the [\[The minimizer is\]\(matlab: createExitMsg\('barrier',2.000000e+00,true,true,'fmincon',5.679537e-11,'default</a></p></div><div data-bbox=\)](matlab: helpview([docroot '/toolbox/optim/</a></p></div><div data-bbox=)

gamma beta0 sigmab

-0.5056	2.5579	1.1816
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The value of the negative log-likelihood is

536.5876

Question 4

[fmincon stopped because the \[the default value of the \\[satisfied to within the default value of the \\\[\\\\[The minimizer is\\\\]\\\\(matlab: createExitMsg\\\\('barrier',2.000000e+00,true,true,'fmincon',8.972069e-11,'default</a></p></div><div data-bbox=\\\\)\\\]\\\(matlab: helpview\\\(\\\[docroot '/toolbox/optim/msg\\\_csh/optim\\\_msg\\\_csh.map'\\\], 'local\\\_min\\\_possible</a></p></div><div data-bbox=\\\)\\]\\(matlab: helpview\\(\\[docroot '/toolbox/optim/msg\\_csh/optim\\_msg\\_csh.map'\\], 'local\\_min\\_possible</a></p></div><div data-bbox=\\)\]\(matlab: helpview\(\[docroot '/toolbox/optim/msg\_csh/optim\_msg\_csh.map'\], 'local\_min\_possible</a></p></div><div data-bbox=\)](matlab: helpview([docroot '/toolbox/optim/msg_csh/optim_msg_csh.map'], 'local_min_possible</a></p></div><div data-bbox=)

gamma	beta0	sigmab	u0	sigmau	rho
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-0.6798	3.1532	1.8790	1.4566	1.6036	0.4382
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The value of the negative log-likelihood is

463.3630