

Homework 5: ECON512

Joonkyo Hong

For question 1 and 2, the relevant values are -1257.07 and -796.589, respectively.

Tables below are summarizing starting values of the functions, initial parameters, maximized values of log-likelihood function, and the arg max for each case. For this exercise, rather than estimating $\sigma_{\beta,u}$, I estimate ρ which is the correlation between β_i and u_i . For the first two cases, I employ logit estimates without constant for the initial values for γ and β_0 and one for σ_β . For the last case, I employ logit estimates with constant and the constant is the initial value for u_0 . For σ_u , I use one.

Table 1: Simple Model with Gaussian Quadrature

Case	γ	β_0	σ_β	function value
Initial	-0.3272	1.4935	1	-571.7613
At maximum	-0.5056	2.4832	1.4055	-536.2378

Table 2: Simple Model with quasi Monte Carlo

	γ	β_0	σ_β	function value
Initial	-0.3272	1.4935	1	-111.1193
At Maximum	-0.5056	2.5579	1.3962	-76.0706

Table 3: Full Model with quasi Monte Carlo

Case	γ	β_0	u_0	σ_β	σ_u	ρ	function value
Initial	-0.3613	1.4825	0.7384	1	1	0	7.4112
At Maximum	-0.6759	2.9606	1.3015	1.8491	1.5358	0.4311	65.6452

```

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Homework #5 ECON 512 %
% Written by Joonkyo (Jay) Hong, 18 Nov 2018 %
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
clear;

addpath('./CETools/'); % First, add path CETools %

% Load dataset

load 'hw5.mat';

x=reshape(data.X,100*20,1);
z=reshape(data.Z,100*20,1);
y=reshape(data.Y,100*20,1);
dta = [y x z];

% Option set for fmincon
options_opt = optimoptions('fmincon', 'Algorithm', 'interior-point', 'Display', 'iter', 'StepTolerance',
    'TolFun',1e-4,'MaxIter',1e2, 'MaxFunEvals', 1e8);

% Initial Values for Q1 and Q2 (Logit Estimates)
init_theta = glmfit([z x],y,'binomial','link','logit','constant','off');
init_theta = [init_theta' 1];

% Initial Values for Q4 (Logit Estimates)
init_theta2 = glmfit([z x],y,'binomial','link','logit');
init_theta2 = [init_theta2(2:3,1)' init_theta2(1,1) 1 1 0];

%% Question 1. Simple with Gaussian Quadrature Approach

k = 20; % # of nodes for GQ approach
lik_fcn1 = @(theta) loglik_GQ(theta,dta,k);

% Constraints in parameter space
% gamma, beta0, sigma_beta

lb = [-inf -inf 0];
ub = [inf inf inf];

% Initial Values for Optimization and Initial value of likelihood function

```

```

fcnval_for_Q1 = -lik_fcn1([0, 0.1, 1]);
init_fcn1 = -lik_fcn1(init_theta);

% Minimizing minus log likelihood

tic
[theta_mle1,fval1,exitflag1,~] = fmincon(lik_fcn1,init_theta,[],[],[],[],lb,ub,[],options_opt);
time1 = toc;

%% Question 2. Simple with Quasi-Monte Carlo

k = 100; % # of nodes for q-MC approach
lik_fcn2 = @(theta) loglik_qMC(theta,dta,k);

% Constraints in parameter space
% gamma, beta0, sigma_beta

lb = [-inf -inf 0];
ub = [inf inf inf];

% Initial Values for Optimization and Initial value of likelihood function

fcnval_for_Q2 = -lik_fcn2([0, 0.1, 1]);
init_fcn2 = -lik_fcn2(init_theta);

% Minimizing minus log likelihood

tic
[theta_mle2,fval2,exitflag2,~] = fmincon(lik_fcn2,init_theta,[],[],[],[],lb,ub,[],options_opt);
time2 = toc;

%% Question 4. Full with Quasi-Monte Carlo

k = 200; % # of nodes for q-MC approach
lik_fcn4 = @(theta) loglik_full(theta,dta,k);

% Constraints in parameter space
% gamma, beta0, u0, sigma_beta, sigma_u, rho

lb = [-inf -inf -inf 0 0 -1];
ub = [inf inf inf inf inf 1];

```

```

% Initial Values for Optimization and Initial value of likelihood function

init_fcn4 = -lik_fcn4(init_theta2);

% Minimizing minus log likelihood

tic
[theta_mle4,fval4,exitflag4,~] = fmincon(lik_fcn4,init_theta2,[],[],[],[],lb,ub,[],options_opt);
time4 = toc;

%% Question 5. Report the results

disp("
");
disp("Case 1: Simple with Gaussian Quadrature");
disp("Initial");
disp(num2str(init_theta));
disp("MLE Estimates");
disp(num2str(theta_mle1));
disp("Function Value");
disp("Initial");
disp(num2str(init_fcn1));
disp("Maximand");
disp(num2str(-1*fval1));

disp("
");
disp("Case 2: Simple with quasi-Monte Carlo");
disp("Initial");
disp(num2str(init_theta));
disp("MLE Estimates");
disp(num2str(theta_mle2));
disp("Function Value");
disp("Initial");
disp(num2str(init_fcn2));
disp("Maximand");
disp(num2str(-1*fval2));

disp("
");
disp("Case 3: Full with quasi-Monte Carlo");
disp("Initial");

```

```
disp(num2str(init_theta2));  
disp("MLE Estimates");  
disp(num2str(theta_mle4));  
disp("Function Value");  
disp("Initial");  
disp(num2str(init_fcn4));  
disp("Maximand");  
disp(num2str(-1*fval4));
```