Problem Set 4

Due on Monday, June 17, h 13:00. Mail box F230.

Huggett model (30 points)

The aim of this problem set is to have you compute Huggett (1993) with incomplete markets. The parameter values in the benchmark calibration are listed in Table 1.

Parameter	Description	Value
β	Discount factor	0.9932
α	CRRA coeff.	1.5
$y(e)$	Income if $s = e$	1
$y(u)$	Income if $s = u$	0.5
$\pi(e\|e)$	Transition matrix	0.97
$\pi(u\|u)$	Transition matrix	0.5
$\underline{a}$	Borrowing limit	-2

Table 1: Benchmark calibration, Huggett (1993)

Let the (discretized) space of asset holdings be $A = [-2, 5]$. As a first try, you can use an equispaced grid with $N = 1000$ points (Hint: use the function `linspace` to generate the grid). The discretized space for the shock is simply $S = \{e, u\}$.

1. Solve Huggett's model for the parametrization given in Table 1. You can follow the basic algorithm outlined in Lecture 4, section on "Computational method", and use the Matlab files uploaded on ILIAS as a template. The main file is `main_huggett`. At the beginning of this file, you can set up the parameters (the ones listed in Table 1). Then, you have to go through the following steps:

   (a) Set an initial interval for the bond price: $[q_{min}, q_{max}]$.

   (b) Given an initial value for q (if you use bisection, just set $q = \frac{q_{\min}+q_{\max}}{2}$), solve the household problem. To solve the household problem, you should call the function `solve_household`, described on page 45, Lecture 4. You also have to fill in the missing parts within the function file. After solving the household problem, you should know what the value function and the policy functions are.

(c) In this step you solve for the invariant distribution $\mu(a,s;q)$ using the function `solve_mu`. Give as inputs the policy function for assets obtained in the previous steps and the Markov chain for the exogenous shock s. Fill in the missing parts in `solve_mu`.

(d) Now that you have $\mu(a,s;q)$ you can compute total assets demand

$$ED(q) = \sum_a \sum_s a \cdot \mu(a,s;q)$$

If $ED(q) > 0$, raise the bond price, if it is < 0, lower the bond price, and iterate on these steps until you achieve convergence. Once the algorithm converged, report the equilibrium value for q and for the interest rate (recall that $q = (1+r)^{-1}$).

2. After solving for the equilibrium, produce the following graphs:

   (a) Plot $V(a,u)$ and $V(a,e)$.

   (b) Plot $g(a,u)$, $g(a,e)$ together with the line $a' = a$. What is the ergodic set for assets?

   (c) Plot the probability density functions $\mu(a,u)$ and $\mu(a,e)$. Plot in a separate graph the *cumulative* density functions: $F(\widehat{a},u) = \sum_{a \leq \widehat{a}} \mu(a,u)$ and $F(\widehat{a},e) = \sum_{a \leq \widehat{a}} \mu(a,e)$.

   (d) Compute and plot the Lorenz curve (together with the line of perfect equality). Compute and report the Gini coefficient for wealth.

3. Choose one of the following experiment and implement it:

   (a) Cut in half the borrowing limit: $\underline{a} = -1$. Report some relevant statistics that you deem important.

   (b) Double the duration of unemployment, i.e. set $\pi(u|u) = 0.75$. Report some relevant statistics that you deem important.

Remark. If your code runs too slow, reduce the number of gridpoints for assets from 1000 to 500 (or even less, depending on your PC).