Problem Set 8

1 Numerical Questions

Consider following setting. There is a continuum of workers with identical probability λ of being fired each period when they are employed. With probability $\mu \in (0,1)$, each unemployed worker receives one offer to work at wage w drawn from the cumulative distribution function $F(w)$. If she accepts the offer, the worker receives the offered wage each period until she is fired. With probability $1-\mu$, an unemployed worker receives no offer this period. The probability μ is determined by the function $\mu = \mu(U)$, where U is the unemployment rate, and $\mu'(U) < 0$, $\mu(0) = 1$, $\mu(1) = 0$. A worker's utility is given by $\mathbb{E}\sum_{t=0}^{\infty}\beta^t y_t$, where $\beta \in (0,1)$ and y_t is income in period t, which equals the wage if employed and zero otherwise. There is no unemployment compensation. Each worker regards U as fixed and constant over time in making her decisions.

The two key equations are

$$V^u = \mu(U)\int_0^B \max\left\{\frac{w'}{1-\beta(1-\lambda)} + \frac{\beta\lambda}{1-\beta(1-\lambda)}V^u, \beta V^u\right\} dF(w') + (1-\mu(U))\left(\beta V^u\right). \tag{1}$$

$$\mu(U)\left(1-F(\overline{w})\right)U = \lambda\left(1-U\right). \tag{2}$$

We define a *stationary equilibrium* as an unemployment rate U, and a policy function $\overline{w}$, such that the policy function solves the worker's problem in equation (**??**) and the unemployment rate U satisfies the stationary requirement in equation (**??**).

Write a Matlab program to numerically solve for a *stationary equilibrium.* Use $\beta = 0.9$, and $\mu(U) = \mu_0(1-\sqrt{U})$, with job loss rate λ. Discretize the wage offer distribution as we have done in the previous assignments. This time use 41 discrete values for $w \in [0,20]$. Also use a discrete approximation to a log normal distribution for the wage offer distribution $F(w)$; $\log w \sim N(0,1)$.

The probability a worker receives a wage offer is given by

$$\mu(U) = \mu_0(1-\sqrt{U}),$$

where μ_0 is a positive scalar.

In this question we want to calibrate this economy to have an unemployment rate of

9.7 percent and a job destruction rate of 1.5 percent. We want to do this by choosing appropriate values for λ and μ_0. Specifically, we want to search over values of λ and μ_0 so that the steady state unemployment rate is 9.7 percent and the job destruction rate is 1.5 percent. We will assume that we know all the rest of the structure of the model and the wage offer distribtuion.

You can use the following sample code as a template. This code is for a simple search model, where there is no wage distribution, and unemployed workers receive exogenous job offers (at the same wage) at rate μ. Employed workers loose their jobs at rate λ. Thus, the steady state unemployment rate in this economy is $U = \lambda / (\lambda + \mu)$, and the job destruction rate is λ.

```
function answer = calibrate()
% File name: calibrate.m
% Calibrate a VERY simple search model

% suppose Unemployment rate = 10 percent
% Job destruction rate      =  5 percent


guess = [0.025; 0.50];  % begin with a guess for lambda and mu

empty1 = zeros(1,1);    % these are just place holders to illustrate how
empty2 = ones(1,10);    % to pass exogenous variable to the function

% here we set the options for the minimization algorithm
options = optimset('display', 'iter');
   % 'display', 'iter' : This prints out the current value of the function each iteration

% The following line calls the Matlab function "fminsearch" starting with
% our initial "guess".  Look at the help file for "fminsearch" for more details
% We want fminsearch to choose the value of x that minimizes our function "objective"
x = fminsearch(@(x) objective(x, empty1), guess, options)

  function output = objective(x, model_parameters)
  % This function computes the unemployment rate and job destruction rate
  % for a simple job search model (no reservation wage) and computes the
  % the sum of squared deviations from an unemployment rate of 9.7% and a
  % job destruction rate of 2.5%

  % IN:      2-by-1 vector x, where x(1) will hold the current guess for lambda and
  %          x(2) will hold the current guess for mu

  % OUT:     scalar output, equal to the sum of squared deviations from 9.7% unemployment
  %          and 2.5% job destruction

    lambda = x(1);    % Give the economic name lambda to the variable x(1)
    mu     = x(2);    % Give the economic name mu to the variable x(2)

    U      = lambda / (lambda + mu);   % Calculate the stationary unemployment rate
    E2U    = lambda;                   % Calculate the job destruction rate

    moments = zeros(2,1);
```

```
    moments(1) = (0.097 - U)./0.097;     % Use relative deviations from the truth
    moments(2) = (0.025 - E2U)./0.025;   % for the moments

    output = sum(moments.^2);           % Assign value to the output
  end

end
```