

# Numerical Methods for Ph. D Students in Economics

## Homework 3

1. (LQ approximation) Write a subroutine that calculates matrices  $Q$ ,  $R$ , and  $W$  (or a matrix  $\begin{pmatrix} Q & W \\ W' & R \end{pmatrix}$ ) for any given return  $r(X, u)$ , where  $X$  and  $u$  have arbitrary length. Also write a subroutine that calculates  $A$ ,  $B$ , and  $C$  for any given constraint function  $g(X, u, \epsilon)$  where  $X$ ,  $u$ , and  $\epsilon$  have arbitrary length.
2. Write a subroutine that takes above matrices  $Q$ ,  $R$ ,  $W$ ,  $A$ ,  $B$ , and  $C$  as inputs and calculates the fixed point  $P$  of Riccati equation by iteration. Apply it to the economy given in example 1.1 in the notes.
3. Write a subroutine that takes above matrices  $Q$ ,  $R$ ,  $W$ ,  $A$ ,  $B$ , and  $C$  as inputs and calculates the fixed point  $P$  of Riccati equation by Vaughn's method. Apply it to the economy given in example 1.1 in the notes and compare your result with that you obtained in 2.
4. Write the log likelihood function as a user-defined function. For a given set of parameters, generate data using policy function obtained in 3. Using that data, estimate the parameters via MLE.