— PROBLEM SET 2 —
Y1: MACROECONOMETRICS
UNIVERSITY OF HELSINKI, FEBRUARY 2012

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This problem set involves coding an economic model. Hence, you should decide are you using Iris-toolbox or Dynare. See the course website for more information.

—EXERCISE 1. (VARIANCE OF AN ENDOGENOUS VARIABLE)—

As in the first exercise of the first problem set, consider the following scalar stochastic process

$$x_t = \rho x_{t-1} + \varepsilon_t, \quad \varepsilon_t \sim \text{iid}(0, \sigma^2), \ t = 0, \pm 1, \pm 2, \dots$$

Assume further that $|\rho| < 1$.

Calculate the variance of x_t. How is this related to the next two exercises?

—EXERCISE 2. (CODING THE NEW-KEYNESIAN MODEL)—

Consider the New-Keynesian model (equations (25)–(27) in the slides). Some assumptions related to the model parameters are listed in early parth of the slides. Assume that instead of (27), the monetary policy is given by

$$i_t = \rho + \phi_\pi \pi_t + \phi_y y_t + s_t,$$

where s_t is *a monetary policy shock*. Let's assume it is (strong) white noise[1].

Assume the following parameter values $\sigma = 1$, $\beta = 0.99$ $\lambda = 0.1$, shock variances 0.01 (if needed), $\phi_\pi = 1.5$, $\phi_y = 0.2$ and $\rho = -\log \beta$.

(a) Code the model using the model language[2]. This means that code all the listed equations. (This is something I showed you during the lecture.)

(b) Solve the steady state. What are the steady-state values of the variables?

(c) Study the the BK conditions (dynare command `check;`).[3]

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[1]See lecture notes.

[2]The model parser reads this code and forms the matrices for the Klein solution algorithm.

[3]Dynare command `check` or Iris command `eig(m)`

(d) Set the parameter $\phi_\pi = 0.9$. Study the BK conditions. What happens? Having $\phi_\pi < 1$ violates so-called Taylor principle, ie the central bank does not respond actively to inflation deviating from the target (target is zero here).

—EXERCISE 3. (SAME WITH PERSISTENT SHOCKS)—

Code another version of the previous model assuming that

$$d_t = \rho_d d_{t-1} + \epsilon_t^d, \quad \epsilon_t^d \sim \text{iid}(0, \sigma_d^2)$$

$$m_t = \rho_m m_{t-1} + \epsilon_t^m, \quad \epsilon_t^m \sim \text{iid}(0, \sigma_m^2)$$

$$s_t = \rho_s s_{t-1} + \epsilon_t^s, \quad \epsilon_t^s \sim \text{iid}(0, \sigma_s^2)$$

Using the following parameter values

$\rho_d = 0.6$	$\sigma_d^2 = 0.01$
$\rho_m = 0.8$	$\sigma_m^2 = 0.01$
$\rho_s = 0.4$	$\sigma_s^2 = 0.01.$

(a) Code the model using the model language. This means that code all the listed equations.

(b) How does the deterministic steady state differ from the steady-state of the previous exercise?

(c) Study the existence of the BK condition.[4]. Why they list more eigen-values than in the previous exercise?

(d) Set the parameter $\phi_\pi = 0.9$. Study the BK conditions. What happens?

—EXERCISE 4. (CALIBRATING THE ECONOMIC MODEL)—

Consider the model from the previous exercise. Suppose that your economic data says that the variance of inflation is 0.8^2 and the variance of the output gap is 0.95^2. Your task is to calibrate the economic model of the previous exercise to match these data moments. This means that you should change the parameters of the model (including the shock variances) such that the variances of inflation and output gap of the model economy are close to those values you observe in the data. You may compute the model variances by dynare command `stoch_simul`

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[4]Dynare command `check` or Iris command `eig(m)`