ISCTE–IUL, Exam, Macroeconomics, MSc Economics, 25/10/2014.

ISCTE — INSTITUTO UNIVERSITÁRIO DE LISBOA

Master in Economics

Macroeconomics

Exam

25 October 2014 **Duration: 2 hours**

Group I – 2.5 points each

Question 1 (Matlab). Using your knowledge about the Matlab package, write down a simple code in order to:

(i) Have represented in the same figure the following three functions:

$$\begin{aligned} f(x) &= 2x^2 + 3x + 6 \\ g(x) &= -4x + x^2 \\ z(x) &= x \end{aligned}$$

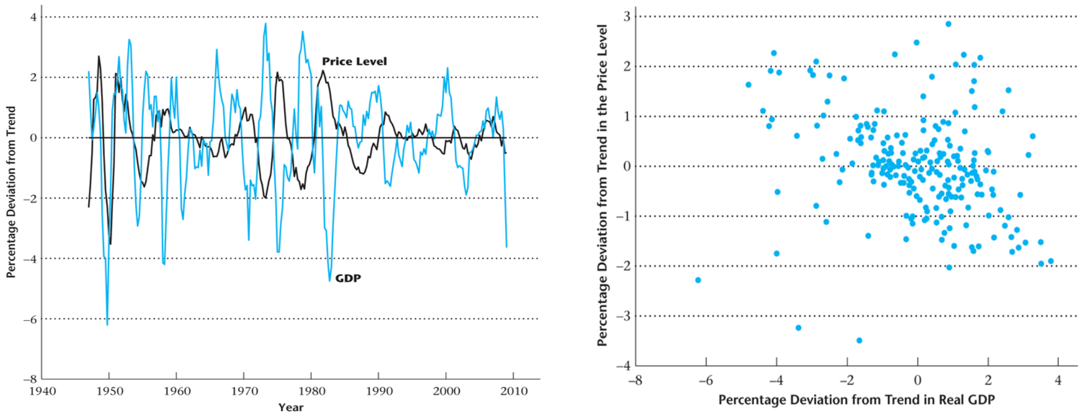
with x defined in the interval $[-2, 4]$. **(10 points)**

(ii) To show the dynamics of the following stochastic process (x_t):

$$x_{t+1} = 2 + 0.5x_t + (1/10)\varepsilon_t$$

where ε_t is a IID random variable, with mean equal to zero and variance equal to 1. In Matlab this random variable is written as: `randn(1)`. Simulate the dynamics of this process for $t = [1, 80]$. **(10 points)**

Question 2 (HP filter). Consider the next two figures. They represent the evolution of GDP and the Price Level with respect to the long term trend of each one, for the US economy in post World War II period.



Looking at the left panel, the mostly used tool in modern macroeconomics to obtain such type of dynamics is the Hodrick–Prescott filter (HP filter). Explain in a *detailed manner* the basic properties of this tool. If it is of any use, its formula is given by

$$\min_{\tau_t} \sum_{t=1}^{T} \{(y_t - \tau_t)^2 + \lambda[(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2\}$$

where y_t is the original series, τ_t is the smooth trend and $(y_t - \tau_t)$ is the HP filtered series. Parameter λ gives us how much curvature we are ready to accept in the filtered data. **(25 points)**

Group II – 5 points each exercise

Answer only to 3 exercises from the following set: A,B,C,D (D is compulsory)

A. Real Business Cycles. Assume a small scale Real Business Cycle model, the dynamics of which can be described by four fundamental equations, as follows:

$$\begin{aligned}
Y_t/N_t &= [\xi/(1-\alpha)]\, C_t \\
Y_t &= A_t K_{t-1}^{\alpha} N_t^{1-\alpha} \quad , \quad \alpha = 0.5 \\
\ln A_t &= (1-\rho)\ln A^* + \rho \ln A_{t-1} + \varepsilon_t \quad , \quad |\rho| < 1 \\
Y_t &= C_t + I_t
\end{aligned}$$

Capital letters represent variables measured in actual values, and the symbols closely follows materials covered in classes. It is also known that in the steady state the following information holds: the rates of growth of K_t and I_t are both equal to 4%, and the rate of growth of N_t is 1% .

1. Rewrite this small version of the model with variables expressed in terms of growth rates**.**

2. Calculate, relatively to the "steady state", the values for the growth rates of the endogenous variables (remember, assuming that $|\rho| < 1$).

3. Assume now that the rate of growth of K is given by the following equation

$$k_t = \lambda E_t k_{t+1} + (1/5)2x_t \quad , (\lambda) > 0$$

   where x_t represents the the output gap. Determine the equilibrium level of k_t.

4. Now consider also that

$$x_t = 1\% + 0.5x_{t-1} + \varepsilon_t$$

   with ε_t as white noise. Recalculate all growth rates in the steady state, given this new information.

B. Rules versus Discretion. Assume that the Central Bank's loss function is given by the following function:

$$L = \beta\left(u - u^*\right) + \gamma\left(\pi - \pi^*\right)^2$$

u is the unemployment rate, γ and β are parameters, and π is the inflation rate. An asterisk is used to represent the central bank's desired values for each variable.
We know that the behavior of the supply side of the economy can be described by the following Phillips Curve with a supply a shock given by e_t:

$$u = u^n - a(\pi - \pi^e) + e_t$$

where u^n is the natural level of unemployment, π^e is the level of expected inflation, and $a = 15$. Finally assume that private agents have rational expectations

$$\pi^e = \pi.$$

1. Explain the logic behind the Loss function above, as far as the targets of the central bank are concerned.

2. Assuming that $u^* = 5\%, \pi^* = 0$, determine the level of optimal inflation in the case of discretionary behavior by the central bank.

3. Determine the same as in the previous question, but now having the central bank displaying commitment to maintain inflation at the level of its natural rate.

4. Explain why the result in (3) is better than the result in (2).

5. What is the condition that should hold in order to have the same result in both scenarios: discretion and commitment. What is the relevance for monetary policy of this theoretical major result?

C. The Poole Model. Consider an economy characterized by an IS–LM model with Rational Expectations. The IS function is given by

$$y_t = -b(i_t - E_t\pi_{t+1}) + z_t$$

where y stands for output, i for the nominal interest rate, $E_t\pi_{t+1}$ is expected in‡ation, z is an exogenous shock and b is a parameter $(b > 0)$.

The LM curve expresses the real money demand in log values $(m_t - p_t)$ as dependent upon output, the interest rate and exogenous shocks (v_t) as follows:

$$m_t - p_t = y_t - \alpha i_t + v_t \quad , \qquad \alpha > 0$$

For simplicity, assume that the price level is constant and equal to $P_t = 1$, which implies that $p_t = 0$.

Assuming that the main goal of the central bank is to minimize the variance of the percentage deviations of output with respect to its long term expected value — that is minimizing $E[y-y^*]^2$— one can obtain these results:

$$\begin{aligned} E[y-y^*]^2_{i^*} &= \sigma_z^2 \\ E[y-y^*]^2_{m^*} &= \left(\frac{b}{2\alpha+b}\right)\sigma_v^2 \end{aligned}$$

1. Explain what factors determine whether i or m is a better policy instrument in order to reduce the volatility of short term business cycles.

2. Assume that $\alpha = 0$. What instrument looks better now? Explain your answer in terms of economic intuition.

3. Assume that σ_v^2 is twice as large as σ_z^2, and $\alpha = 5; b = 10$. What is the best policy instrument in this case? Explain.

4. And what about if $\alpha = 5; b = 40$ (and σ_v^2 continues to be twice as large as σ_z^2).Explain.

D. NKM and determinacy. Assume the New Keynesian Model represented by the usual structure: an Aggregate Supply function (AS), the demand side function (IS), and a simple rule for interest rate policy. The symbols are as follows: π_t is the inflation rate, x_t is the output gap, i_t is the nominal short term interest rate to be fixed by the central bank.

$$\begin{aligned} \pi_t &= \beta E_t\pi_{t+1} + \lambda x_t \\ x_t &= E_t x_{t+1} - a\left(i_t - E_t\pi_{t+1}\right) \\ i_t &= 2\% + vE_t\pi_{t+1} \end{aligned}$$

where (β, λ, a, v) are parameters.

1. Rewrite the model in matricial form, in order to study its stability.That is write the model according to this rule
$$\mathbf{A}\cdot\mathbf{E}_t\mathbf{z}_{t+1}=\mathbf{B}\cdot\mathbf{z}_t+\mathbf{C}\cdot\mathbf{v}_t$$
where $\mathbf{z}_{t+1},\mathbf{z}_t,\mathbf{v}_t,\mathbf{C}$ are vectors, while $\mathbf{A}$ and $\mathbf{B}$ are matrices.

2. For the following set of parameter values $\beta=0.9$, $\lambda=0.5$, $a=2.7$, study the stability of this model for the scenario:
$$\text{Scenario A}:\ v=0.2$$
knowing that $A^{-1}\times B=\begin{bmatrix}\frac{1}{\beta} & -\frac{1}{\beta}\lambda\\ -\frac{1}{\beta}\left(a-av\right) & \frac{1}{\beta}\lambda\left(a-av\right)+1\end{bmatrix}$

3. What would you conclude about the main message of the New Keynesian Model as far as the fight against inflation is concerned? Propose alternatives (no numerical support for these alternatives is required).

$$A = \begin{bmatrix} \beta & 0 \\ (a - av) & 1 \end{bmatrix}, inverse: \begin{bmatrix} \frac{1}{\beta} & 0 \\ -\frac{1}{\beta}(a - av) & 1 \end{bmatrix} = A^{-1}, \text{ inverse: } A$$

$$B = \begin{bmatrix} 1 & -\lambda \\ 0 & 1 \end{bmatrix}$$

$$A^{-1} \times B = \begin{bmatrix} \frac{1}{\beta} & 0 \\ -\frac{1}{\beta}(a - av) & 1 \end{bmatrix} \times \begin{bmatrix} 1 & -\lambda \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} \frac{1}{\beta} & -\frac{1}{\beta}\lambda \\ -\frac{1}{\beta}(a - av) & \frac{1}{\beta}\lambda(a - av) + 1 \end{bmatrix}$$

$$\begin{bmatrix} \frac{1}{0.9} & -\frac{1}{0.9}0.5 \\ -\frac{1}{0.9}(2.7 - 2.7 \times 0.2) & \frac{1}{0.9}0.5(2.7 - 2.7 \times 0.2) + 1 \end{bmatrix}, \text{ eigenvalues: } 2.1255, -0.20329$$