Sample final-test: Macroeconomics (M8674)

ISCTE-IUL, Instituto Universitário de Lisboa

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- **Answer the questions below using paper and pen, or a Pluto notebook, as required. (100 minutes + 20 minutes tolerance)**
- **In the case of the hand-written answers, make sure that your calligraphy is legible. Otherwise, students will be asked to explain the content of their answers in an oral meeting, and their grades will have to be delayed.**

Question 1 (100 points) : requires paper & pen only

Consider the standard RBC model with logarithmic consumption utility. A solution to the intertemporal problem, by a benevolent government (or a central planner), can be obtained from the formal problem stated below:

$$\max_{\{c_t,\ell_t k_{t+1}\}_{t=0}^{\infty}} \quad \sum_{t=0}^{\infty} \beta^t \left(\ln c_t - \theta \frac{\ell_t^{1+\gamma}}{1+\gamma} \right)$$

$$\text{subject to:} \quad a_t k_t^{\alpha} \ell_t^{1-\alpha} = c_t + k_{t+1} - (1-\delta)k_t$$

$$c_t, c_{t+1} \geq 0 \ , \quad \ell_t, \ell_{t+1} \in (0,1) \ , \quad 0 < \beta \leq 1$$

with the usual four remaining equations in the models' structure:

$$\begin{aligned} k_{t+1} &\equiv i_t + (1-\delta)k_t \\ y_t &= a_t k_t^{\alpha} \ell_t^{1-\alpha} \\ y_t &\equiv c_t + i_t \\ \ln a_t &= (1-\rho)\ln \bar{a} + \rho \ln a_{t-1} + \varepsilon_t \quad , \quad \varepsilon_t \sim iid\left(0, \sigma^2\right) \end{aligned}$$

1. Derive the First Order Conditions (FOCs) for consumption, labor, and capital. **(25points)**
2. Simplify the FOCs by eliminating the Lagrange multipliers from the solution. **(15points)**
3. Write down the set of nonlinear equations that are required for obtaining a solution to the government problem. *No linearization is required here.* **(25 points)**
4. Suppose that the linearized version of the model can be simulated with the four equations presented below. Write them in state space form (matrix form). **(35 points)**

$$\begin{aligned} \hat{a}_{t+1} &= \rho \cdot \hat{a}_t + \varepsilon_{t+1} \\ \hat{k}_{t+1} &= \frac{1}{\beta}\hat{k}_t + \frac{\delta}{\phi}\hat{a}_t - \frac{\delta(1-\phi)}{\phi}\hat{c}_t + \frac{\delta(1-\alpha)}{\phi}\hat{\ell}_t \\ \mathbb{E}_t\hat{\ell}_{t+1} &\approx \frac{1}{\gamma+\alpha}\left(\hat{a}_{t+1} + \alpha\hat{k}_{t+1} - \mathbb{E}_t\hat{c}_{t+1}\right) \\ \hat{c}_t &\approx \mathbb{E}_t\hat{c}_{t+1} - \varphi\left[\hat{a}_{t+1} + (\alpha-1)\hat{k}_{t+1} + (1-\alpha)\mathbb{E}_t\hat{\ell}_{t+1}\right] \end{aligned}$$

Question 2 (100 points) Questions: 1+5 on paper; {2,3,4} in a notebook

Consider the baseline New Keynesian Model with a monetary policy shock (e_t). Its basic equations are as follows (the remaining equations are exactly the same as in classes):

$$\begin{aligned}
&\text{IS :} && \hat{y}_t = \mathbb{E}_t\hat{y}_{t+1} - \frac{1}{\sigma}\left(i_t - \mathbb{E}_t\pi_{t+1} - r^n\right) \\
&\text{Taylor rule :} && i_t = \pi_t + r^n + \phi_\pi(\pi_t - \pi^T) + \phi_y\hat{y}_t + e_t \quad , \quad r^n = \pi^T = 0 \\
&\text{AS :} && \pi_t = \kappa\hat{y}_t + \beta \cdot \mathbb{E}_t\pi_{t+1} \\
&\text{Monetary policy shock :} && e_t = \rho_e \cdot e_{t-1} + \varepsilon_t^e \quad , \quad \varepsilon_t^s \sim iid(0,1)
\end{aligned}$$

where $\{\hat{y}, i, r^n, \pi, e, \varepsilon\}$ are, respectively, the output-gap, nominal interest rate, natural real interest rate, inflation rate, monetary shock, and a random disturbance. The parameters assume the following values:

σ	ρ_u	μ	ψ	β	ϕ_π	ϕ_y	α	γ
0.7	0.75	0.8	1.2	0.95	0.5	0.5	0.6	0.8

and

$$\kappa = \frac{\psi(1-\mu)(1-\mu\beta)}{\mu}$$

1. Write the model in state-space form (matrix form). *We advise you to follow the order used in our classes.* **(35 points)**

2. Using a Pluto notebook of your choice, what kind of dynamics (stability/instability) do we have in this model? Justify. *For this task, we strongly suggest you use a copy of the notebook used in classes and adapt it to the needs of this exercise.* **(15 points)**

3. Using the same notebook, simulate the impact on all variables of an exogenous shock of +1 on e_t. Is this shock contractionary or expansionary? *Explain in the notebook by creating a new markdown cell.* **(15 points)**

4. Given what you obtained in the previous question, do you agree with the criticisms of the NKM raised by Estrella and Fuhrer (see slides)? *Explain in the notebook by creating a new markdown cell* **(15 points)**

5. Ambrose Evans-Pritchard is the "The Telegraph"s International Business Editor and a highly respected economist and journalist. On May 5, his following article was published in that newspaper: "The Bank of England is the prisoner of a dying economic cult". Read the article (7 minutes) by clicking the blue link. In your opinion, how relevant is the NKM for policy-making institutions in today's world? **(20 points)**

End of test