Master in International Economics & Public Policy

Macro in Python

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Session contents

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1 Sessions 1 to 3: Introduction to Python

- Starting Python and first commands
- Introductory topic 1: Utility maximization
  Consider the utility function $u(C_X, C_Y)$ and a budget constraint $p_X C_X + p_Y C_Y = w$ with obvious notation.

1. Choose a functional form for the utility function.
2. Plot a figure with two indifference curves.
3. Add the budget constraint.
4. Illustrate the optimal consumption point (C_X^*, C_Y^*) by plotting an indifference curve that is tangent to the budget constraint. Solving for optimal consumption levels analytically.

- Introductory topic 2: Demand and supply on the labour market
  Consider a consumption-leisure choice that follows the utility function

$$U(c,l) = \left[\gamma c^\theta + (1-\gamma) l^\theta\right]^{\frac{1}{\theta}}, \ \theta < 1$$

  and a budget constraint $pc = (\bar{l} - l) w^{\text{nominal}}$. The optimal leisure choice is given by (compare Makro I, Bachelor Wiwi JGU)

$$l(w) = \frac{1}{1 + (\frac{\gamma}{1-\gamma})^{\frac{1}{1-\theta}} w^{\frac{\theta}{1-\theta}}} \bar{l}, \quad \text{with} \quad w = \frac{w^{\text{nominal}}}{p}.$$

1. Plot isoquants for the above utility function.
2. Plot a budget constraint
3. Plot the labour supply function.
4. Assume a Cobb-Douglas production function. Let the demand function for labour be given by (again, see Makro I)

$$L^D = \left(\frac{(1-a)\,A}{w}\right)^{1/a} K$$

5. Plot the labour demand function.

6. Combine both the labour supply function and labour demand function in one plot and visualize the equilibrium of the labour market. Highlight the equilibrium wage.

- Introductory topic 3 - Finding roots

1. Remind yourself of what a root of a function $y = f(x)$ is. Plot x on the horizonal and y on the vertical axis. Plot examples of graphs of $f(x)$ that display a (real) root and those that do not.

2. Construct a function $f(w)$ that gives you the equilibrium wage as a root.

3. Find the root in Python by using the `root_scalar(method='brentq')` command from the `scipy` library.

- Introductory topic 4 - solving ODEs

  Plot a phase diagram for the Solow growth model

2 Session 4: Assignment of topics

2.1 Topics

1. Compute the equilibrium price and quantity on the labour market analytically and numerically.

2. Plot a phase diagram for the Solow growth model (solving ODEs).

3. Plot a phase diagram for the neoclassical growth model with optimal saving (solving ODEs).

4. Replicate the figure on business cycles from Advanced Macro.

5. Plot a phase diagram for the Pissarides matching model in Advanced Macro.

6. Compute stress dynamics in the stress model.

7. Compute indifference surfaces and budget constraints for a three-period utility maximization problem (compare time-inconsistency in Advanced Macro).

8. more to come (Grossman-Helpman growth model, your own suggestions, social groups and social cohesion ...)

3 Sessions 5 to 11: Q&A

4 Last session: Presentations