CENTER FOR
ECONOMIC
BEHAVIOR &
INEQUALITY

Introduction to code and exercises

Lectures at IIES

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Python

1. **Pre-knowledge:**
   1.1 Python
   1.2 VSCode
   1.3 git

   Online-course Introduction to Programming and Numerical Analysis
   QuantEcon cheetsheet for MATLAB vs. Python.
2. **Updated Python:** Install (or re-install) newest Anaconda
3. **Packages:** `pip install quantecon, EconModel, consav`
4. **GEMoodel tools:**
   4.1 Clone the GEModelTools repository
   4.2 Locate repository in command prompt
   4.3 Run `pip install -e .`

Packages

- **EconModel:**
  1. Standardized interface for economic models
  2. Easy use of just-in-time compilation using *numba*

  EconModelNotebooks/01. Using the EconModelClass.ipynb

  Video: On YouTube
- **ConSav:** Collection of tools for consumption-saving models

  In particular: See *ConSavNotebooks/04. Tools/**
- **GEModelTools:** My version of the SSJ toolbox

HANCGovModel

- **No production.** No physical savings instrument
- **Households:** Get stochastic endowment z_{it} of consumption good
- **Government:**
  1. Choose government spending
  2. Collect taxes, τ_t, proportional to endowment
  3. Bonds: Pays 1 consumption good next period. Price is $p_t^B < 1$.

$$p_t^B B_t = B_{t-1} + G_t - \int \tau_t z_{it} d\boldsymbol{D}_t$$

$$\tau_t = \tau_{ss} + \varphi \left(B_{t-1} - B_{ss} \right)$$

- **Market clearing:**

$$B_t = A_t^{hh}$$

Households

Households:

$$
\begin{aligned}
v_t(z_{it}, a_{it-1}) &= \max_{c_{it}} \frac{c_{it}^{1-\sigma}}{1-\sigma} + \beta \mathbb{E}_t \left[v_{it+1}(z_{it+1}, a_{it}) \right] \\
\text{s.t. } p_t^B a_{it} + c_{it} &= a_{it-1} + (1-\tau_t) z_{it} \geq 0 \\
\log z_{it+1} &= \rho_z \log z_{it} + \psi_{it+1} \quad , \psi_{it} \sim \mathcal{N}(\mu_\psi, \sigma_\psi), \; \mathbb{E}[z_{it}] = 1
\end{aligned}
$$

Euler-equation:

$$
c_t^{-\sigma} = \beta \frac{\underline{v}_{a,t+1}(z_{it}, a_{it})}{p_t^B}
$$

Envelope condition:

$$
\underline{v}_{a,t}(z_{it-1}, a_{it-1}) = c_{it}^{-\sigma}
$$

Questions: Stationary Equilibrium

1. **Define the stationary equilibrium**
2. **Solve and simulate the household problem**
   with $p_{ss}^{B} = 0.975$ and $\tau_{ss} = 0.12$.
3. **Find the stationary equilibrium**
   with $G_{ss} = 0.10$ and $\tau_{ss} = 0.12$.
4. **What happens for** $\tau_{ss} \in (0.11, 0.15)$?
5. **When is average household utility maximized?**

Questions: Transition path

Same model. Your choice of τ_{ss}. New questions:

1. **Define the transition path.**
2. **Plot the DAG**
3. **How does the Jacobians look like?**
4. **Find the transition path for** $G_t = G_{ss} + 0.01 G_{ss} 0.95^t$
5. **What explains household savings behavior?**
6. **What happens to consumption inequality?**

More exercises

- **Master course at University of Copenhagen:** Advanced Macroeconomics: Heterogenous Models
  1. Assignment I
  2. Assignment II