Project 0: Inaugural Project

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Vision: The inaugural project teaches you to solve a simple economic model, and present the results.

- **Objectives:** In your inaugural project, you should show that you can:
  1. Apply simple numerical solution and simulation methods
  2. Structure a code project
  3. Document code
  4. Present results in text form and in figures
- **Content:** In your inaugural project, you should:
  1. Solution and simulation of pre-specified economic model (see next page)
  2. Visualization of solution

  Example of structure: See this repository.
- **Structure:** Your data analysis project should consist of:
  1. A README.md with a short introduction to your project
  2. A single self-contained notebook (.ipynb) presenting the analysis
  3. (Optionally) Fully documented Python files (.py)
- **Hand-in:** On GitHub by uploading it to the folder:

  github.com/projects-2020-YOURGROUPNAME/inauguralproject/

  1. Add your group to this list
  2. Create your GitHub repository here
  3. Follow step 2-3 in this guide to upload
- **Deadline:** 16th of March 23.59
- **Exam:** Your inaugural project will be a part of your exam portfolio.
  You can incorporate feedback before handing in the final version.

Labor Supply Problem

Consider a consumer solving the following maximization problem

$$\begin{aligned} c^\star, \ell^\star &= \arg\max_{c,\ell} \log(c) - \nu \frac{\ell^{1+\frac{1}{\varepsilon}}}{1+\frac{1}{\varepsilon}} \\ &\text{s.t.} \\ x &= m + w\ell - [\tau_0 w\ell + \tau_1 \max\{w\ell - \kappa, 0\}] \\ c &\in [0, x] \\ \ell &\in [0, 1], \end{aligned} \tag{1}$$

where c is consumption, ℓ is labor supply, m is cash-on-hand, w is the wage rate, τ_0 is the standard labor income tax, τ_1 is the top bracket labor income tax, κ is the cut-off for the top labor income bracket, x is total resources, ν scales the disutility of labor, and ε is the Frisch elasticity of labor supply.

Note that utility is monotonically increasing in consumption. This implies that

$$c^\star = x. \tag{2}$$

Questions

1) Construct a function which solves eq. (1) given the parameters.

We choose the following parameter values

$$m = 1,\ \nu = 10,\ \varepsilon = 0.3,\ \tau_0 = 0.4,\ \tau_1 = 0.1,\ \kappa = 0.4$$

2) Plot $\ell^\star$ and $c^\star$ as functions of w in the range 0.5 to 1.5.

Consider a population with $N = 10,000$ individuals indexed by i.
Assume the distribution of wages is uniform such that

$$w_i \sim \mathcal{U}(0.5, 1.5).$$

Denote the optimal choices of individual i by $\ell_i^\star$ and $c_i^\star$.

3) Calculate the total tax revenue given by

$$T = \sum_{i=1}^{N} \left[\tau_0 w_i \ell_i^\star + \tau_1 \max\{w_i \ell_i^\star - \kappa, 0\}\right].$$

4) What would the tax revenue be if instead $\varepsilon = 0.1$?

Consider a politician who wishes to maximize the tax revenue.

5) Which τ_0, τ_1 and κ would you suggest her to implement?
   Report the tax revenue you expect to obtain.