Modeling Demand

Short Course on CGE Modeling, United Nations ESCAP

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Introduction

- In CGE models, final demand is derived from the utility maximization problem of a representative household (or in some cases households).
- This is a very familiar problem, but working through it carefully will provide us with a number of insights into how CGE-type models are constructed in practice.
- In this session we will review the basic consumer problem, work through a example, and finally implement the model in GAMS.

Session Outline

1. The utility maximization problem
2. Example using Cobb-Douglas
3. Building the model in GAMS
   - Setting up the model
   - Calibration
   - Simulation and testing

Utility Maximization

- Consider a consumer that has preferences satisfying the axioms of consumer choice, and where their preferences can be summarized by the utility function $U = U(c_1, c_2)$, where c_i is consumption of the ith good.
- The usual properties apply to the utility function (i.e., continuity, monotonicity, and quasi-concavity).
- The consumer choice problem can be viewed as choosing c_1 and c_2 such that the consumer maximizes $U = U(c_1, c_2)$ subject to the budget constraint $Y = p_1 c_1 + p_2 c_2$, where Y is money income.
- We assume an internal solution for simplicity.

Formal Problem

The problem can be written:

$$\max \quad U(c_1, c_2) \quad \text{s.t.} \quad Y = p_1 c_1 + p_2 c_2$$

or equivalently:

$$\max \quad \mathscr{L} = U(c_1, c_2) + \lambda[Y - p_1 c_1 - p_2 c_2]$$

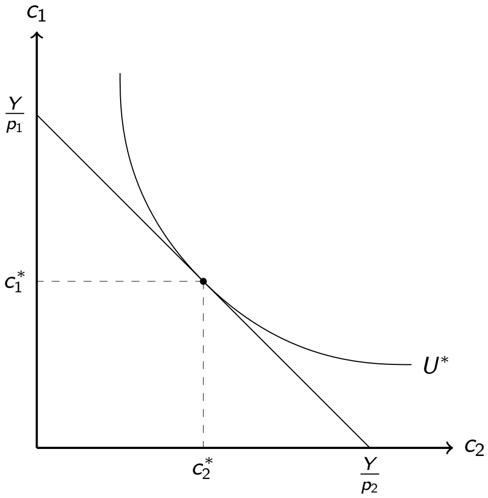
The first order conditions are:

$$\partial \mathscr{L} / \partial c_1 = \partial U / \partial c_1 - \lambda p_1 = 0$$
$$\partial \mathscr{L} / \partial c_2 = \partial U / \partial c_2 - \lambda p_2 = 0$$
$$\partial \mathscr{L} / \partial \lambda = Y - p_1 c_1 - p_2 c_2 = 0$$

Interpretation

- The solution to the maximization problem is the simultaneous solution to these three equations for c_1, c_2 and λ, expressed in terms of p_1, p_2 and Y.
- At an optimum, the consumer will spend all income, and the marginal utility per dollar spent on each good must equal the marginal utility of income (λ).
- Another way of interpreting the conditions is that the money value of the utility generated by the last unit of each good purchased must equal its price.
- Solving explicitly for the optimal consumption bundles yields the Marshallian demand functions.

Geometric Interpretation



Example - Cobb-Douglas Utility

Suppose that the utility function takes the form $U = \alpha c_1^{\beta} c_2^{1-\beta}$, where $0 < \beta < 1$. The Marshallian demands will be:

$$
\begin{aligned}
c_1 &= \beta Y / p_1 \\
c_2 &= (1-\beta) Y / p_2
\end{aligned}
$$