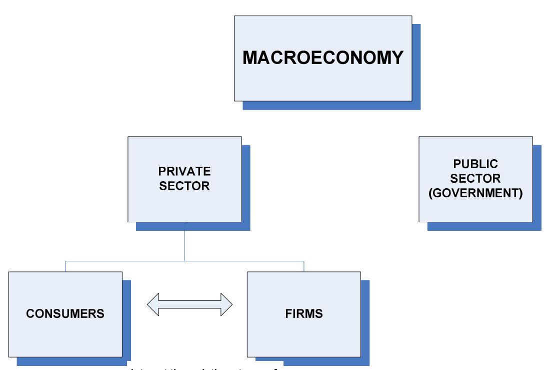
MACROECONOMIC THEORY AND POLICY: OVERVIEW

SEPTEMBER 12, 2011

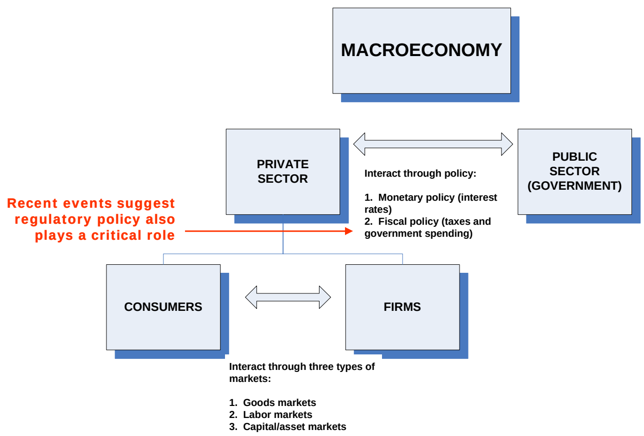
BUILDING BLOCKS OF AN ECONOMY



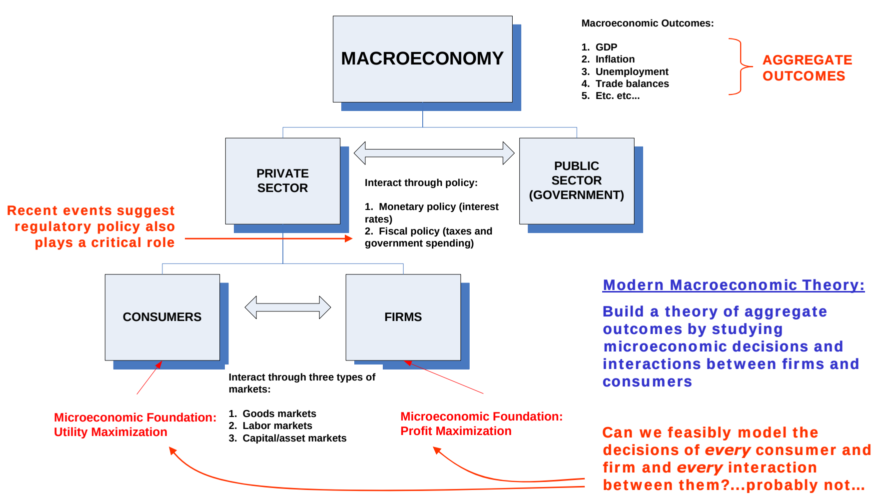
Interact through three types of markets:

1. Goods markets
2. Labor markets
3. Capital/asset markets

Building Blocks of an Economy



Building Blocks of an Economy



Modern Macroeconomic Theory:

Build a theory of aggregate outcomes by studying microeconomic decisions and interactions between firms and consumers

Can we feasibly model the decisions of *every* consumer and firm and *every* interaction between them?...probably not...

REPRESENTATIVE-AGENT MACROECONOMICS

- Consumer A: Consumed $50 in Year X
- Consumer B: Consumed $75 in Year X
- Consumer C: Consumed $100 in Year X
- Consumer D: Consumed $125 in Year X
- Consumer E: Consumed $150 in Year X

No other consumers in the economy

THE REPRESENTATIVE CONSUMER

- Aggregate (i.e., economy-wide) consumption = $500
- Average consumption = $100
- Macroeconomics often most concerned with aggregate outcomes
- If we want to take a micro-based approach to explaining aggregate outcomes…
- …model Consumer C's behavior / decision-making
- A simplistic approach – turns out to yield surprisingly rich results, insights, and predictions

REVIEW OF CONSUMER THEORY

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UTILITY FUNCTIONS

- **Describe how much "happiness" or "satisfaction" an individual experiences from "consuming" goods – the benefit of consumption**
- **Marginal Utility**
  - The extra total utility resulting from consumption of a small/incremental extra unit of a good
  - Mathematically, the (partial) slope of utility with respect to that good

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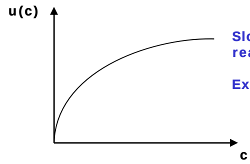
    Alternative notation: du/dc OR $u'(c)$ OR $u_c(c)$ OR $u_1(c)$
- **One-good case: $u(c)$, with $du/dc > 0$ and $d^2u/dc^2 < 0$**
  - Recall interpretation: strictly increasing at a strictly decreasing rate
  - Diminishing marginal utility
- **Two-good case: $u(c_1, c_2)$, with $u_i(c_1, c_2) > 0$ and $u_{ii}(c_1, c_2) < 0$ for each of $i = 1,2$**
  - Utility strictly increasing in each good individually (partial)
  - Diminishing marginal utility in each good individually
- **Easily extends to N-good case: $u(c_1, c_2, c_3, c_4, \ldots, c_N)$**

UTILITY FUNCTIONS

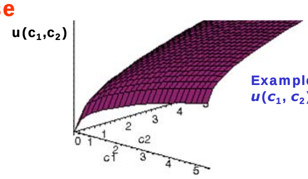
- **One-good case**



Slope (marginal utility) asymptotes to (but never reaches…) zero

Example: $u(c)$ = ln c or $u(c)$ = sqrt(c)

- **Two-good case**



Example: $u(c_1, c_2)$ = ln c_1 + ln c_2 or $u(c_1, c_2)$ = sqrt(c_1) + sqrt(c_2)

UTILITY FUNCTIONS

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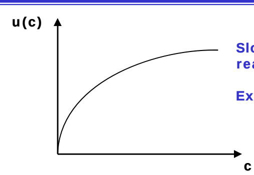

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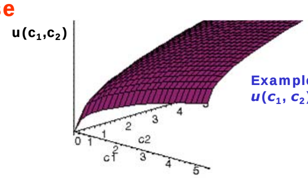

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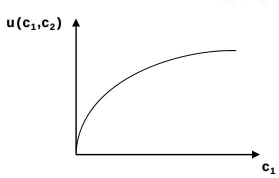
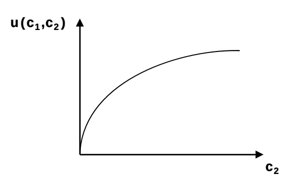
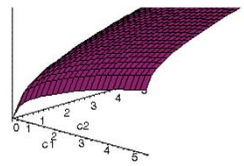
Viewed in good-by-good space





UTILITY FUNCTIONS

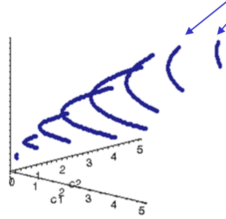
Alternative views

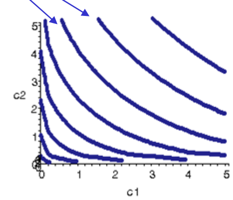


Emphasizing the contours

Indifference Curve: the set of all consumption bundles that deliver a particular level of utility / happiness

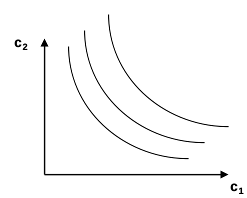
Viewing only the contours from directly overhead





UTILITY FUNCTIONS

- Marginal Rate of Substitution (MRS)
  - **Maximum** quantity of one good consumer is **willing** to give up to obtain **one** extra unit of the other good
  - Graphically, the (negative of the) slope of an indifference curve
  - MRS is itself a **function** of c_1 and c_2 (i.e., $MRS(c_1, c_2)$)



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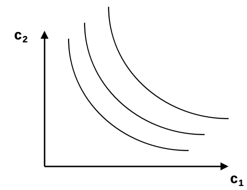
- **Marginal Rate of Substitution (MRS)**
  - **Maximum quantity of one good consumer is willing to give up to obtain one extra unit of the other good**
  - **Graphically, the (negative of the) slope of an indifference curve**
  - **MRS is itself a function of c_1 and c_2 (i.e., $MRS(c_1, c_2)$)**
  - **MRS equals ratio of marginal utilities**
    - $$MRS(c_1,c_2) = \frac{u_1(c_1,c_2)}{u_2(c_1,c_2)}$$
    - **Using Implicit Function Theorem (see Problem Set 1)**

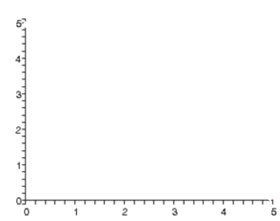


- **Summary: whether graphically- or mathematically-formulated, utility functions describe the benefit side of consumer optimization**

BUDGET CONSTRAINTS

- **Describe the cost side of consumption**
- **One-good case (trivial): $Pc = Y$**
  - **Assume income Y is taken as given by consumer for now**
- **Two-good case (interesting): $P_1c_1 + P_2c_2 = Y$**
  - **Assume income Y is taken as given by consumer for now**

Plotted in 2D-consumption-space



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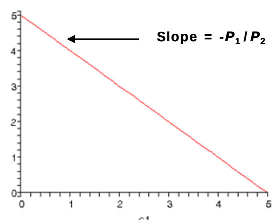

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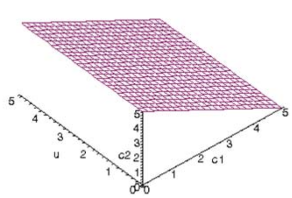
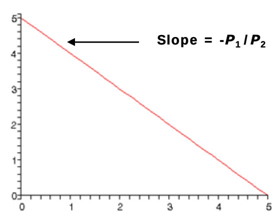
Plotted in 3D-consumption-space

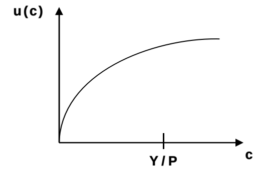


Plotted in 2D-consumption-space



Consumer Optimization

- **Consumer's decision problem:** maximize utility subject to budget constraint – bring together both cost side and benefit side
- **One-good case**
  - Trivially, $c = Y / P$ is optimal choice
  - No decision to make here…



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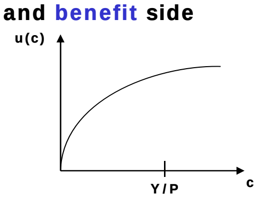
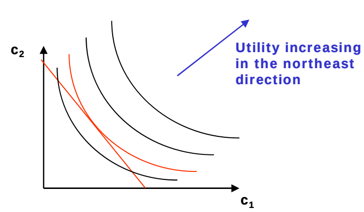


- **Two-good case**
  - How to optimally allocate Y across the two goods c_1 and c_2?
  - A non-trivial decision problem…



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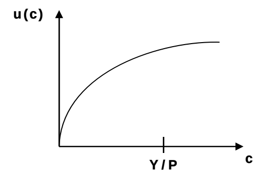

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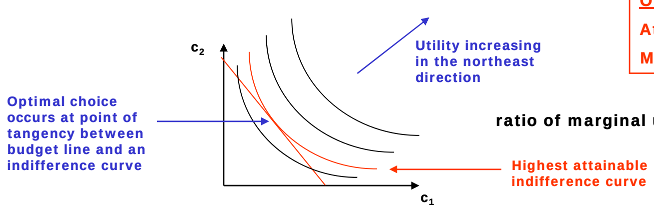

OPTIMALITY CONDITION:
At the optimal choice,
MRS = slope of budget line

ratio of marginal utilities = price ratio

Lagrange Analysis

- Consumer optimization a **constrained optimization** problem
  - Maximize some function (utility function)…
  - …taking into account some restriction on the objects to be maximized over (budget constraint)
- **Lagrange Method:** mathematical tool to solve constrained optimization problems
- General mathematical formulation
  - Choose (x, y) to maximize a given objective function $f(x,y)$…
  - …subject to the constraint $g(x,y) = 0$ (Note formulation of constraint)

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- Lagrange Method: mathematical tool to solve constrained optimization problems
- General mathematical formulation
  - Choose (*x*, *y*) to maximize a given objective function *f*(*x*,*y*)…
  - …subject to the constraint *g*(*x*,*y*) = 0 (Note formulation of constraint)
  - Step 1: Construct Lagrange function

Lagrange multiplier

$$L(x, y, \lambda) = f(x, y) + \lambda g(x, y)$$

  - Step 2: Compute first-order conditions with respect to *x*, *y*, and *λ*

1) $f_x(x, y) + \lambda g_x(x, y) = 0$

2) $f_y(x, y) + \lambda g_y(x, y) = 0$

3) $g(x, y) = 0$

Rationale: setting first derivatives to zero isolates maxima (or minima…technically, need to check second-order condition…)

The Mathematics of Consumer Theory

Lagrange Analysis

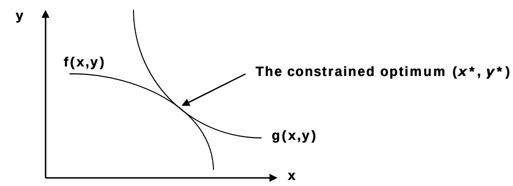
- Step 3: Solve the system of first-order conditions for *x*, *y*, and *λ*
  - Often most interested in simply eliminating the multiplier…
  - …
  - …
  - …
  - Optimality condition: at the optimum (*x**, *y**)

Lagrange Analysis

- **Step 3: Solve the system of first-order conditions for *x*, *y*, and *λ***
  - **Often most interested in simply eliminating the multiplier…**
  - …
  - …
  - …
  - **Optimality condition: at the optimum (x^*, y^*)**

$$\frac{f_x(x^*, y^*)}{f_y(x^*, y^*)} = \frac{g_x(x^*, y^*)}{g_y(x^*, y^*)}$$

Graphical interpretation: at the constrained optimum, the function *f*(.) is tangent to the function *g*(.)



Lagrange Analysis

- **Apply Lagrange tools to consumer optimization**
- **Objective function: $u(c_1,c_2)$**
- **Constraint: $g(c_1,c_2) = Y - P_1c_1 - P_2c_2 = 0$**

- **Step 1: Construct Lagrange function**

$$L(c_1, c_2, \lambda) = u(c_1, c_2) + \lambda\left[Y - P_1c_1 - P_2c_2\right]$$

- **Step 2: Compute first-order conditions with respect to c_1, c_2, λ**

- **Step 3: Solve (with focus on eliminating multiplier)**

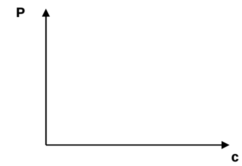
$$\frac{u_1(c_1^*, c_2^*)}{u_2(c_1^*, c_2^*)} = \frac{P_1}{P_2}$$

OPTIMALITY CONDITION

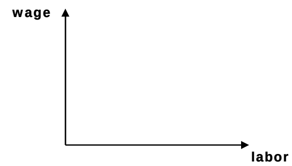
i.e., MRS = price ratio

THE THREE MACRO (AGGREGATE) MARKETS

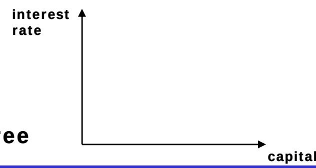
- **Goods Markets**



- **Labor Markets**



- **Capital / Savings / Funds / Asset Markets**



- **Will put micro-foundations under all three**