EC2102 Macroeconomic Analysis I

Wednesdays, 2-4pm

LT11

Dr Serene Tan

Office Hours: Wednesdays 12-1 and 4-5pm

or by appointment

Office: AS2/05-26

Course Grade

15%	Tutorial participation
35%	Midterm (week 7, March 3, 2-4pm, MPSH1)
50%	Final exam (April 26)

Format of tutorials

Tutorials start in WEEK 3; tutorials every week

All assignments handed out the week before

Do your assignments seriously; not graded

Tutorial participation, including tutorial attendance, COUNTS

No Webcasting

Who should you go to for help?

Textbook

Williamson, Stephen D. (2008), "Macroeconomics," 3rd edition, Pearson Addison Wesley.

Figures 1.1, 1.2, 1.3 and 1.4

Questions interested in addressing

What causes economic growth?

What causes business cycle fluctuations?

Should governments intervene to smooth business cycles?

What we do in this course

1. address these questions by constructing coherent frameworks
   – i.e., build up macroeconomic models with <u>microfoundations</u>

2. examine the Neoclassical/New Keynesian controversy over differing policy prescriptions

Tools required to succeed in this class

consistency!
know your microeconomics
comfortable using mathematical notation to express economic concepts
basic differentiation
active tutorial participation

Preliminaries

1. Why microfoundations? Why should we care about what an "agent" does?

Because the economy consists of many of these individual agents, who, at any point in time, are making decisions on how much to consume/save, how much to work, how much human capital to accumulate, etc

Recall AS-AD diagram? What is AD? Where does it come from?

Aggregate consumption is the aggregation of invididual consumption decisions; aggregate investment is the aggregate of individual firms' investment decisions

Impact of increase in transportation fares on GDP, inflation?

Impact of high oil prices on GDP?

2. Why math?

Because *modern* economics uses math, which is both compact and precise

If you feel you need help with math, pick up Alpha Chiang's "Fundamental Methods of Mathematical Economics," McGraw-Hill

Structure of Lectures

Foundation:

First 3 lectures: individual's intertemporal consumption/savings decision (ch. 4: pp. 99-120, ch. 8)
Next 2 lectures: introduce the firm's intertemporal problem (ch. 4: pp. 121-133, ch. 9)
Next lecture: the complete real intertemporal model (same as above); after recess

Midterm (week 7)

1 lecture: introduce money (ch. 10)

Equilibrium Models of Business Cycles

Next 1 to 2 lectures: RBC Model (ch. 11, 3)
Next 2 to 3 lectures: IS-LM/AS-AD framework (ch. 12)

One extra topic

Final Exam (all topics covered)

Expectations (1/4)

What students should expect to learn from EC2102

- you will learn analytical tools in this class, and use them to analyze policies/events

- you will learn how to begin to think like an Economist

- you will learn that the more you learn, the less you know, or the less comfortable you are with what you think you know

Expectations (2/4)

- you will learn that since Economics is a social science, you have to care about both the "social" and the "science" part
- "social" in the sense that we model human behavior, or one aspect of human behavior (economics aspect), Economists do not pretend to model everything. Implications?
- "science" in the sense that we construct models to explain how individuals behave. Implications?

- bottomline: you will learn to structure your thinking

What students should NOT expect to learn from EC2102 (3/4)

- immutable laws in Economics which are ironclad. (Comment: no such thing. A model is as good as its assumptions)

- understand immediately and completely the "real world." (Comment: there is no set of rules/things to learn, so that once you have learnt them you fully understand Economics. No such thing. You learn as time passes, and when models are shown wrong you come up with new models.)

- forecasting (Comment: Some economists do forecasting, but not all)

Comment: a lot of students think macroeconomics is very "real world" and interesting. Yes, I think it is interesting, but Economics has moved very far away from the Keynesian "all-words-only" newspaper-article-like "description of the world" whether you like it or not. Very mathematical now. Have to be realistic in your expectations.

What students can expect from me (4/4)

- extremely fair

- do my best to teach you what I think you ought to learn.
(Comment: I am a researcher also.)

What I expect from students

- I expect you to learn, not memorize; I want you to be able to take away from this class analytical tools which are useful for further studies in Economics, as well as a way of structured thinking which is useful even years down the road even if you are not an Economics major.

- I expect you to put in effort. There is no such thing as a free lunch. Do not be discouraged if at first it seems heavy-going.

Personal Preference about Communication

I very much prefer to communicate with you face to face. If you have a question, please come to my office hours to see me. Or if you have timetabling clashes, email me to make an appointment.

Large EC2102 Class Size Means...

All TAs hold office hours.

An Individual's Problem: Setup (1/10)

Lives for two periods, periods 1 and 2
- think of period 1 as working life (23-65), and period 2 as retirement (or today vs tomorrow, current vs future)

Time-separable utility function $U(c_1, c_2) = u(c_1) + \beta u(c_2)$,
- subscript denotes time period
- β, the discount factor, takes values between 0 and 1; $\beta \in (0, 1)$ meaures how "patient" consumer is; the higher the β, the more patient

u is the per period utility function
assume: $u'(c) > 0$ and $u''(c) < 0$:
u is strictly increasing and strictly concave; examples:
$u(c) = \ln(c)$; $u(c) = \sqrt{c}$

An Individual's Problem: Setup (2/10)

c_1 and c_2 are units of consumption goods consumed in periods 1 and 2

Assume exogenous income: y_1 and y_2 (in terms of consumption goods)

If he chooses not to consume his entire income in the first period, he can put his savings away, $s_1 > 0$,which earn a real rate of interest r. In the second period he gets back $(1 + r)\, s_1$, principal plus interest.

If he chooses to borrow so as to consume more than his income in the first period, then $s_1 < 0$, and in the second period he pays back $(1 + r)\, s_1$

Think of this as a credit market, where an individual can issue bonds if he wants to borrow, or buy bonds from other individuals if he wants to save.

An Individual's Problem: Setup (3/10)

Assume perfect credit market: no default

Everyone issues bonds and buys bonds at the same rate r

Assume all bonds are traded directly on credit market; no banks

Note: individual's variables denoted by lowercase letters; aggregate (macro) variables denoted by uppercase letters, so c_t is an individual's consumption in period t, and C_t is the aggregate consumption in period t.

Note: All variables are denoted in terms of consumption goods in this model

An Individual's Problem: Setup (4/10)

What is an individual "trying to do" in this economy?

- He knows he lives for two periods, so he wants to maximize his lifetime utility

How does he go about maximizing his lifetime utility?

- Consumption gives him utility, so he wants to consume as much as possible in both periods to maximize lifetime utility

But can this individual consume as much as possible in both time periods 1 and 2?

- No, because he has a budget constraint each period, and he cannot default

An Individual's Problem: Setup (5/10)

What budget constraints?

- first period's budget constraint:

$$y_1 = c_1 + s_1,$$

and s_1 can be positive (saving) or negative (borrowing), or 0 (no borrowing or saving)

- second period's budget constraint:

$$y_2 + (1 + r)s_1 = c_2 + s_2,$$

2 budget constraints contain four unknows: c_1, c_2 and s_1, s_2
but no use for second period savings so must choose $s_2 = 0$
therefore, 3 unknowns, c_1, c_2 and s_1

An Individual's Problem: Setup (6/10)

Example:

$y_1 = 100$ units of consumption goods, $r = 5\%$

If $c_1 = 80$, $s_1 = 20$; consumer is lending in the credit market by buying bonds. In the second period, he gets back his principal of 20 plus $rs_1 = 1$, so $(1 + r)\, s_1 = 21$.

If $c_1 = 120$, $s_1 = -20$; consumer is borrowing in the credit market by issuing and selling his own bonds. In the second period, he pays back the principal of -20 plus $rs_1 = -1$, so $(1 + r)\, s_1 = -21$.

An Individual's Problem: Setup (7/10)

Note:

There is no money yet (we'll add money into the model in week 8). All variables are in **real** terms, measured in units of consumption goods.

Just because there is no money does not mean there are no prices.

- In our model, prices are denoted in units of consumption goods

An Individual's Problem: Setup (8/10)

Saving 1 unit of consumption good in period 1 gets you $(1 + r)$ units of consumption goods in period 2.

the relative price of today's consumption in terms of future consumption is $(1 + r)$
- one unit today is worth $(1 + r)$ units tomorrow

the relative price of tomorrow's consumption in terms of today's consumption is $\frac{1}{1+r}$
- one unit tomorrow is worth $\frac{1}{1+r}$ today

when denoting future values by how much it is worth in the current period, it is called PRESENT VALUE

An Individual's Problem: Setup (9/10)

Recall that budget constraints in each period are:

$$y_1 = c_1 + s_1 \quad (1)$$

$$y_2 + (1+r)s_1 = c_2 \quad (2)$$

Manipulating (2), we can write

$$s_1 = \frac{c_2 - y_2}{1+r} \quad (3)$$

Substituting (3) into (1) , we get

$$\underbrace{c_1 + \frac{c_2}{1+r}}_{\text{PV of consumption}} = \underbrace{y_1 + \frac{y_2}{1+r}}_{\text{PV of income}},$$

Lifetime Budget Constraint (LBC)

An Individual's Problem: Setup (10/10)

LBC now contains only two unknows: c_1 and c_2

Denote $\omega = y_1 + \frac{y_2}{1+r}$ as lifetime wealth. Hence, the LBC can be expressed as

$$c_1 + \frac{c_2}{1+r} = \omega$$

In other words, you consume out of your lifetime wealth

An Individual's Utility Max. Problem

The agent wishes to maximize his lifetime utility subject to his lifetime budget constraint being satisfied, i.e.,

$$\begin{aligned} \max_{c_1,c_2} \; U(c_1,c_2) &= u(c_1)+\beta u(c_2) \\ \text{subject to} \; c_1+\frac{c_2}{1+r} &= \omega \end{aligned} \tag{4}$$

objective function: $U(c_1,c_2)$
decision/choice variables: c_1, c_2

Solution is $\left(c_1^*(\omega,r), c_2^*(\omega,r)\right)$ where $\omega = y_1 + y_2/(1+r)$ is the lifetime wealth of the individual.

Note: the individual chooses both periods' consumption in period one. In period two he simply implements the decision taken in period one

An Individual's Utility Max. Problem: Graphical solution (1/2)

from LBC, we can write c_2 as a function of c_1 :

$$c_2 = (1+r)y_1 + y_2 - (1+r)c_1 = (1+r)(\omega - c_1)$$

Put a graph of the LBC (figure 1)

(y_1, y_2) is endowment point

if $c_1 < y_1$, $s_1 > 0$ (consumer is a lender)

if $c_1 > y_1$, $s_1 < 0$ (consumer is a borrower)

if $c_1 = y_1$, $s_1 = 0$ (consumer is neither a borrower nor a lender)

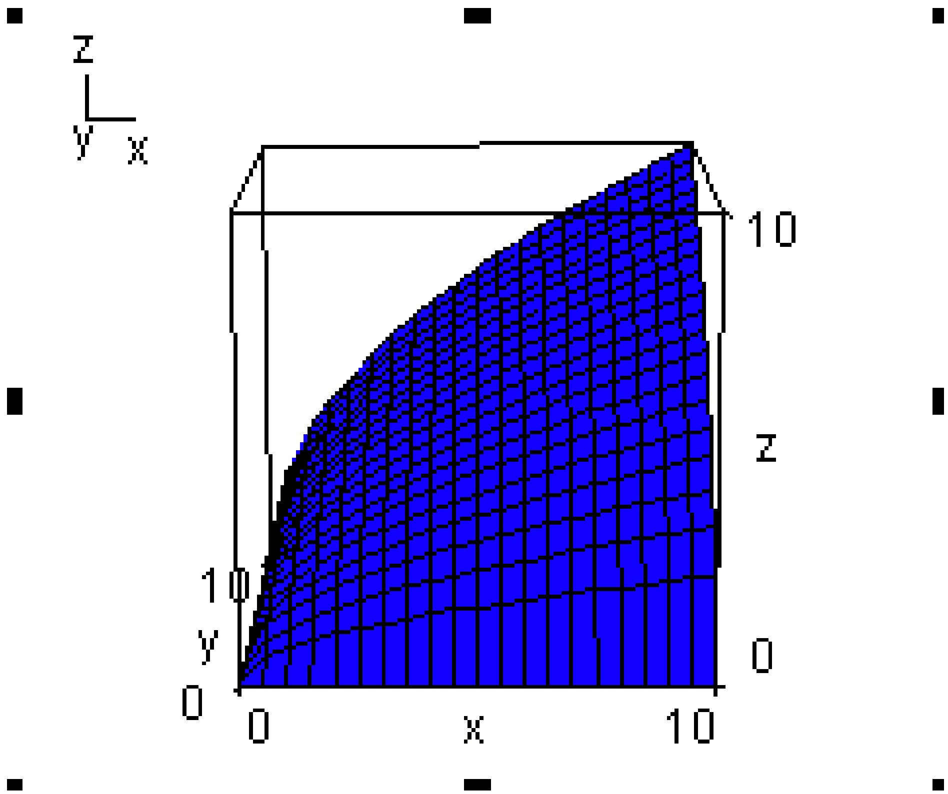
An Individual's Utility Max. Problem: Graphical solution (2/2)

Now for indifference curves, ICs (figure 2)

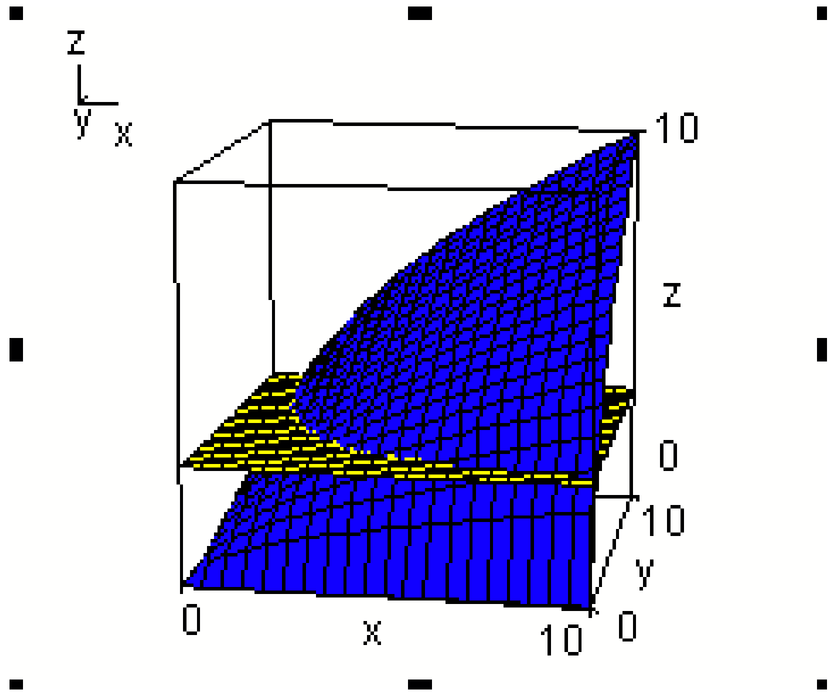
Equilibrium (figure 3)

Indiffrence Curves

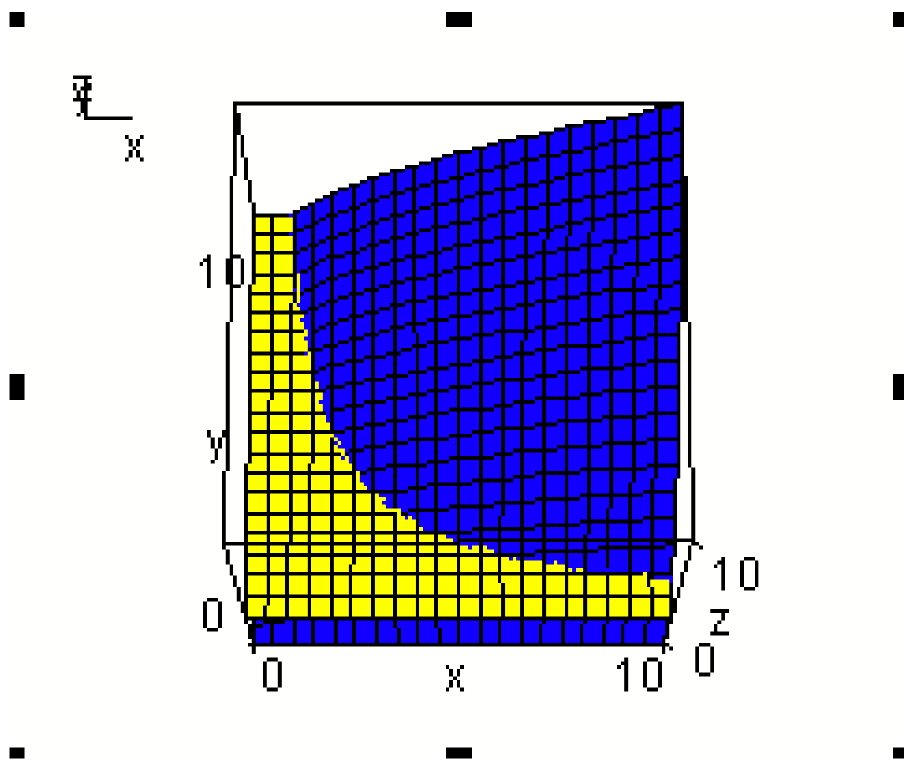
How do you visualize indifference curves? Take for example utility function $u(x, y) = \sqrt{xy}$. Utility function can be seen in 3D:



and indifference curves (level sets) are just "horizontal slicings" of this utility function, so for example



and when you look at the above from a bird's eye view, the part of this "horizontal plane" that "cuts" the utility function is the indifference curve:



An Individual's Utility Max. Problem: Analytical Solution (1/3)

From LBC, we can write $c_2 = (\omega - c_1)(1+r)$, so we can replace c_2 in the utility function, and our maximization problem is now

$$\max_{c_1} u(c_1) + \beta u\Big(\underbrace{(\omega - c_1)(1+r)}_{c_2}\Big).$$

Now we've got a maximization problem in 1 unknown, c_1, and no constraints!

What are taken as given by the individual here?
- he takes as given (r, y_1, y_2)

Want to solve for unknown, c_1^*, in terms of (r, y_1, y_2). Then we can solve for c_2^* and s_1^* in terms of (r, y_1, y_2) (Figure 4)

An Individual's Utility Max. Problem: Analytical Solution (2/3)

First Order Condition (F.O.C.) with respect to c_1:

$$u'(c_1^*) - \beta(1+r)u'(c_2^*) = 0$$

which is equivalent to

$$\begin{aligned} \frac{u'(c_1^*)}{\beta u'(c_2^*)} &= 1+r \qquad (5) \\ \underbrace{-\frac{u'(c_1^*)}{\beta u'(c_2^*)}}_{MRS_{c_1,c_2}} &= \underbrace{-(1+r)}_{\text{slope of LBC}} \end{aligned}$$

This means that if you are maximizing lifetime utility, you must be choosing consumption bundle $\left(c_1^*, c_2^*\right)$ such that it satisfies **(5)**

An Individual's Utility Max. Problem: Analytical Solution (3/3)

In general cannot obtain an explicit solution because we have not specificed how utility functions look like

Homework:

Let $U(c_1, c_2) = \ln(c_1) + \beta \ln(c_2)$

Write down the individual's maximization problem

Using the same trick as we did above in having only 1 decision variable, solve this maximization problem

What are you solving for? $\left(c_1^*, c_2^*, s_1^*, s_2^*\right)$. Remember to express all of these as functions of (r, y_1, y_2).

Note: you do not have to hand up this homework. It is meant for practice, and for you to understand what we have just been doing.