ECO 10350 PRINCIPLES OF MACRO

LECTURE 1

WHAT DOES ECONOMICS STUDY?

- Recent issue (Jan 2019) of American Economic Review, the premier journal of the profession, includes articles on:
  - Colleges and upward mobility
  - Industrial policy
  - Deflation and interest rates
  - Technology transfers
  - Privacy protection choices
  - Cities and knowledge transfer
  - Patents & Human Genome Project
  - Incentives for government bureaucrats
  - Regulating banks
  - Sales and prices over the business cycle
- Lots more in economics! Insurance, health, crime, education, environment, poverty, discrimination, job choice, immigration, crypto, voting, company structures, labor policy, vaccinations, unions, financial aid, trade, development, public works, fertility, taxation, finance …

DASGUPTA

- You all read up to Chapter 2 in Dasgupta, *Very Short Introduction* – ahem
- What are the big questions that he discusses?

INTEREST RATES AND GROWTH

- Terminology: basis point is one-hundredth of a percentage point, 0.01% = 0.0001
- Rates of Compounding can affect growth rates
  - Annual compounding: $1 invested grows to (1+R) after one year
  - Semi-annual compounding, $1 grows to $\left(1+\frac{R}{2}\right)^{2}$
  - Compounding 360 times, $1 grows to $\left(1+\frac{R}{360}\right)^{360}$
  - Compounding continuously, $1 grows to e^R

  - [360?!? Yup, sometimes. Financial contracts were made before computing power. Was good enough for the Babylonians.]

E

- This odd irrational transcendental number, e, was first used by John Napier and William Outred in the early 1600's; Jacob Bernoulli derived it; Euler popularized it. It is $\lim_{x\to\infty}\left(1+\frac{1}{x}\right)^x$ or $\sum_{x=0}^{\infty}\frac{1}{x!}$. It is the expected minimum number of uniform [0,1] draws needed to sum to more than 1. The area under $\frac{1}{x}$ from 1 to e is equal to 1. Sometimes we write e^R; sometimes exp{R} if the stuff buried in the superscript is important enough to get the full font size.

INVESTMENT AFTER ONE YEAR

M per year	(1 + R/m) ^ m
1	1.05
2	1.050625
4	1.0509453
12	1.0511619
250	1.0512658
360	1.0512674
∞	1.0512711

OVER MORE YEARS

- After 2 years, just apply formula again: \$Z becomes \$Z(1+R), then \$Z(1+R)(1+R)
- Simple recursion solves it easily
- After T years, \$Z becomes $\$Z(1+R)^T$
- Which is separable so once we know what happens to \$1 invested, the rest is easy
- Simple formula assumes rates are constant over time – never true obviously
- Yield curve gives different rates for different maturities
- What is the "correct" interest rate? It's … complicated …

RULE OF 70

- Alt Rule of 72
- At interest rate of R%, initial investment doubles after 70/R years
- Examples and calculations

DISCOUNTING

- Reverse all these to figure out value of money in the future
- How much money do I need to invest today, to get \$W at some date in the future? {opportunity cost}
- Know After T years, \$Z becomes $\$Z(1+R)^T$
- So set $\$W = \$Z(1+R)^T$ and solve for $Z = \frac{W}{(1+R)^T} = W(1+R)^{-T}$
- With R=4%, what is value of \$100 paid after 10 years? 50 years? 100 years?
- Often referred to as **Present Value**

DISCOUNTING FOREVER

- What if I want money forever? What is value of \$W paid next year and every year thereafter forever?
- $\left(\frac{W}{(1+R)^1}+\frac{W}{(1+R)^2}+\frac{W}{(1+R)^3}+\cdots\frac{W}{(1+R)^T}+\cdots\right)=W\left(\frac{1}{(1+R)^1}+\frac{1}{(1+R)^2}+\frac{1}{(1+R)^3}+\cdots\frac{1}{(1+R)^T}+\cdots\right)$
- Does it converge? Suppose it does, and suppose it converges to X = $\left(\frac{1}{(1+R)^1}+\frac{1}{(1+R)^2}+\frac{1}{(1+R)^3}+\cdots\frac{1}{(1+R)^T}+\cdots\right)$
- What is (1+R)X? $\left(1+\frac{1}{(1+R)^1}+\frac{1}{(1+R)^2}+\frac{1}{(1+R)^3}+\cdots\frac{1}{(1+R)^T}+\cdots\right)$
- So … X – (1+R)X = 1; solve for X=1/R
- Alt, if I win \$10m in lottery, how much can I take out every year forever if I never touch the principal?

REMINDER ON PERCENTS

- A percent is just a convenient way of writing a decimal. Just move the decimal
- 15% = 0.15
- 99% = 0.99
- 150% = 1.50
- 1% = 0.01
- 5872% = 58.72

- This can get confusing as for example with US inflation data, commonly reported as, for example, "0.2%" last month. This means that prices increased by 0.002.
- If A is half the size of B then we can say that A is 50% of B. If it were a quarter of the size, it would be 25%. If a number is increasing then there are many ways of expressing this. Sometimes we say that Z is 125% as large as Y; this is the same as saying that Z is Y plus a 25% increase. You can see this from the decimals: 125% = 1.25 = 1 + 0.25, so it is equal to one plus 25%.

REMINDER ON PERCENTS

- This can also get confusing when finding percentages of percentages.
- Many stores try to fool people with this: they offer "50% off and then take another 25% off additionally!" Does this mean that you get 75% off the regular price?
- No! Think for a minute: if they offered "50% off and then take another 50% off additionally," would that mean that they were giving it away for free? No, they're taking half off and then another half off – so you get it for a quarter of the original price (since ½ * ½ = ¼ or 0.5 * 0.5 = 0.25). So offering "50% off and then take another 25% off additionally!" means you get 0.50 off and then another 0.50 * 0.25 = 0.125 off, so the total is 0.50 - 0.125 = 0.375, which is 37.5% of the original price – you get 62.5% off the original price.
- For instance, we might want to find 10% of 10%. We CANNOT just multiply 10*10, get 100, and leave that as the answer! Rather we first convert them to decimals and then multiply: so 0.10 * 0.10 = 0.01 = 1%.

SOLOW GROWTH DECOMPOSITION

- GDP is conventionally notated as Y (National Income but the letter I was already taken, for Investment)
- $Y = Af(K,L)$ National Income depends on technology, A; machines, K; and people's labor, L [+other stuff]
- So growth in Y, % ΔY, depends on growth in A, growth in K, and growth in L (with a little calculus, that's an easy derivation)
- We can expand the formula to include that "other stuff" later

PRISONER'S DILEMMA

	Player A cooperates	Player A competes
Player B cooperates	10,10	12,0
Player B competes	0,12	8,8

- If you are Player A, what do you choose?
  - If you know Player B will cooperate, which is better for you?
  - If you know Player B will compete, which is better for you?
- Would this change, if payoff to (compete, compete) were (1,1)?
- Would this change, if payoff to (compete, cooperate) were (20,0)?

PRISONER'S DILEMMA

	Player A cooperates	Player A competes
Player B cooperates	10,10	12,0
Player B competes	0,12	8,8

- If the game is repeated 10 times, what would you choose? (Solve backwards)
- If the game goes on forever, what would you choose?
  - Now gotta talk strategy
    - In game theory, "strategy" is a plan for a series of moves
  - If strategy of B is "grim" as described by Dasgupta,
    - what is A's payoff from cooperate? Compete?

PRISONER'S DILEMMA

	Player A cooperates	Player A competes
Player B cooperates	10,10	12,0
Player B competes	0,12	8,8

- Cooperate has payoff of 10 each year forever, so 10/R
- Compete has payoff of 12 + 8/R
- Which is larger? Depends on R
- Invest in cooperation
- Is "grim" really a plausible strategy?

PRISONER'S DILEMMA BACKGROUND

	Player A cooperates	Player A competes
Player B cooperates	-2,-2	-1,-12
Player B competes	-12,-1	-10,-10

- This was originally called "Prisoner's Dilemma" by Albert Tucker in 1950 and posed in a slightly different way (more like above)