INTRODUCTION

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Outline

- 1 What's Macro?
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Outline

- 3 Functions and basic math
  - 3.1 Functions
  - 3.2 How to calculate a percentage change
  - 3.3 Exponents
  - 3.4 Solving systems of equations
  - 3.5 Derivatives:
    - Basic derivatives
    - Partial derivatives

What's Macro?

- **Macroeconomics** is the study of the economy as a whole
- **Microeconomics** is the study of individual behavior
- **Economy** is the mechanism by which a society decides what, how and for whom to produce.

Models

- **Models** are simplified versions of reality**.**
- Models have:
  1. **assumptions**: propositions
  2. **implications**: results from the assumptions through logic

Models

- Mathematical models have two kinds of variables:
  1. **exogenous** (generated outside the model): givens
  2. **endogenous** (generated inside): unknowns

Functions and basic math

Functions

- **Functions express relations among variables**

$$Q_d = D(P_b, Y)$$

- Q_d = quantity demanded = dependent variable
- P_b = price of bread = independent variable
- Y = income = independent variable
- D(..) = function

Functions and basic math

- Functional form: $Q_d = c - a \cdot P_b + b \cdot Y$
- a, b and c = parameters

Use econometrics to know functional forms and values of parameters:

$Q_d = D(P_b, Y) = c - a \cdot P_b + b \cdot Y = 60 - 10P_b + 2Y$

Functions and basic math

How to calculate a percentage change

$Q_1 = GDP_{91} = 180$

$Q_0 = GDP_{90} = 160$

Percentage change?

Functions and basic math

$$\frac{\Delta Q}{Q_o} \cdot 100 = \frac{Q_1 - Q_o}{Q_o} \cdot 100 = \left[\frac{20}{160} = 12.5\%\right]$$

Functions and basic math

Exponents

- $X^a \cdot X^b = X^{a+b}$
- $X^a / X^b = X^{a-b}$
- $X^{-a} = 1/X^a$
- $X^0 = 1$

Functions and basic math

- Solving systems of equations

Try to solve the equilibrium price of bread:

$Q = 8 - 2P$ (1)

$Q = 3 + P/2$ (2)

Which one represents the demand?

The supply?

Functions and basic math

- Solve for one of the variables in one of the equations
- Substitute into other equation: you have one less equation and one less unknown.
- Repeat until down to 1 equation and 1 unknown,
- Solve for this unknown
- Move backwards.

Do it!!

Functions and basic math

Solve for Q in (1) and substitute into (2),

$8 - 2P = 3 + P/2$

$P = 2.$

Substituting into (1)

$Q = 4.$

Functions and basic math

Derivatives

1. Basic derivatives
   Derivative: what happens to the dependent variable when the independent variable changes.

$y = f(x)$

Functions and basic math

$$\frac{dy}{dx} = \lim_{\Delta \to 0} \frac{\Delta y}{\Delta x}$$

- $dy/dx = f'(x) = y'$

Functions and basic math

Rules

1. If $y = f(x) = x^{\alpha}$, then
   $dy/dx = f'(x) = y' = \alpha \bullet x^{\alpha-1}$
   Calculate
   1. $y = x^2$
   2. $y = 1/x$

Functions and basic math

2. If $y = c \bullet f(x)$, then $dy/dx = y' = c \bullet f'(x)$
   Calculate
   1. $y = a \bullet x^2$
   2. $y = a$

Functions and basic math

3. If $y = c \cdot f(x) + d \cdot g(x)$,
   then $dy/dx = y' = c \cdot f'(x) + d \cdot g'(x)$

Calculate

1. $y = a \cdot x^{\alpha} + b \cdot x^{\beta}$

Functions and basic math

2. Partial derivative

$y = F(x, z)$

Partial derivative of y respect to x: what happens to y (the dependent variable) if x (one of the independent variables) changes, assuming that the other independent variable z stays constant.

Functions and basic math

$$\frac{\delta y}{\delta x} = F_x(x,z) = F_1(x,z) = y_x$$

Functions and basic math

Example: Aggregate production function:

$Y = F(K, L)$

- Y= output
- K = capital
- L = labour

Marginal Product of Labour (MPL)?

Functions and basic math

- Marginal product of labour (MPL): increase in output when labour increases by one unit keeping capital constant.

$$MPL = \frac{\delta Y}{\delta L} = F_L(K,L) = F_2(K,L) = Y_L$$

Functions and basic math

$Y = A \cdot K^{\alpha} \cdot L^{\beta}$

Calculate MPL

2. The data

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Outline (Closed economy)

- Gross Domestic Product (GDP)
  - Income approach
  - Expenditure approach
- Inflation
  - GDP deflator versus CPI
- Unemployment
- Stocks and Flows

GDP (nominal)

GDP = value of all final G&S produced in the economy during a certain period of time

- Final = bought by final user
- Intermediate = used as input in production

GDP (nominal)

- Value = measured by price in Canadian dollars of the year in which the good is produced

GDP

Two "values"

1. **At market price** = valued at price paid
2. **At factor cost** = valued by adding together the cost of factors of production = **value added**

GDP

- **Value added** by a firm = value of output minus value of intermediate G&S = W + I + R
- $GDP_{FC} = GDP_{MP}$ - indirect taxes
- **Indirect taxes** – paid by consumers when purchasing G&S

GDP

- **Gross** – includes depreciation
- **Net** – does not
- **Depreciation** – decrease in value of a capital (investment) good due to the passing of time (called *capital consumption allowances* in the national accounts)

GDP

NDP = GDP – depreciation

(net) Domestic income (at factor cost) = NDP_{FC}

GDP

Income approach

Y = W + R + I

GDP

In the national accounts:

- Compensation of employees = W
- Corporate profits = R + I
- Non-incorporated business income = W + I + R
- Net interest = I + R = paid by firms to households

GDP

Disposable income = income – personal (direct) taxes

PROBLEM 2

GDP

Expenditure approach

- **Consumption (C):** G&S bought by households
- **Government purchases or expenditure (G):** G&S bought by federal, provincial or municipal governments

GDP

3. **Investment (I):** goods bought by firms for <u>future</u> production

- <u>future</u>: key to differentiate between investment and intermediate goods.

GDP

- Only goods bought by firms (exception: houses).
- Only new goods
- Need to differentiate between savings and investment (used differently in daily life)

GDP

- No Government: S = I
  - Y = C + S
  - Y = C + I
- Government: S + T = I + G
  - Y = C + S + T
  - Y = C + I + G

GDP

- S + (T – G) = I
  - S = private (household) saving
  - (T-G) = public (government) saving
  - S + (T – G) = national saving = private + public saving

Inflation

Nominal GDP measures the value of final goods and services using current prices.

$\sum_i p_{i2006} \bullet q_{i2007}$

Inflation

Real GDP measures the value of final goods and services using prices of a given year (called the base year).

$\sum_i p_{i2000} \bullet q_{i2007}$

GDP deflator =

nominal GDP/real GDP

Inflation

Consumer Price Index (CPI) = average level of prices of goods and services consumed by a typical urban Canadian family

Inflation

CPI versus GDP deflator

1. GDP deflator – G&S produced; CPI - G&S consumed
2. GDP deflator – domestic G&S; CPI – both domestic and imported G&S
3. CPI – fixed weights; GDP deflator – changing weights

PROBLEMS 3 AND 4

Unemployment Rate

Labour force = employed + unemployed

Unemployment rate = 100*unemployed/labour force

Labour-Force Participation Rate = 100* labour force/adult population (15+)

PROBLEM 1

Stocks and Flows

Stock = variable measured at a given point in time

Flow = variable that needs to be measured power unit of time.

TRY PROBLEM 5 ON YOUR OWN