Tutorial 3: Time Series Introduction

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Types of data
Econometrics

- Cross Sectional: multiple units in a given time period
  - ↳ Ex. ECO375 grades from 2020
- Time series: Single unit over time
  - ↳ Ex. Mariam Econ grades over years
- Panel: Multiple units over time
  - ↳ Ex. ECO375 & 475 grades

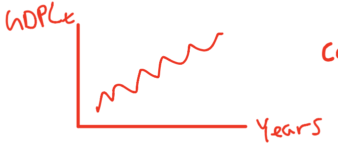
Overview

Example of time series data

① Price of Google stock over days
② Sales of smartphones over years
③ Weight of person over time
④ Min. wage in ON over years

- Time series variable: $\underbrace{\text{single unit}}_{\text{Country: Canada}}$ measured $\underbrace{\text{over time}}_{\text{Years}}$

GDP



- Time series regression: $\underbrace{y_t}_{\text{Price of Apple stock}} = \beta_0 + \beta_1 \underbrace{x_t}_{\text{GDP of U.S.}} + u_t$

Notes about OLS Assumptions

- Random sampling assump. is not required
- No serial correlation: $Cov(u_t, u_s) = 0,\ s \neq t$
- Zero Cond. mean: $E[u_t | X_s] = 0$, for all s

"strong exogenity"

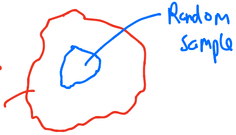
Regression assumptions practice

Chapter 10 Problem 1

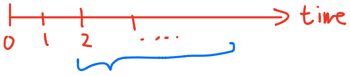
True or False?

1. Like cross-sectional observations, we can assume that most time series observations are independently distributed

Cross sectional



Time series process



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2. The OLS estimator in a time series regression is unbiased under the first three Gauss-Markov assumptions.

unbias

(1) Linear in Param.

(2) No perf. collinearity

(3) Zero. Cond. mean

$\underbrace{\hphantom{Zero Cond mean}}_{\text{strong exogenity}}$

(4) Homoscedasticity

(5) No serial correlation

(6) Normal errors

(7) Realization of stochastic process (implicitly assume)

Effeciency ↓ Standard Errors

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Regression assumptions practice

Chapter 10 Problem 2

$$gGDP_{t-1} = \alpha_0 + \delta_0 int_{t-1} + \delta_1 int_{t-2} + u_{t-1}$$

$$gGDP_t = \alpha_0 + \delta_0 int_t + \delta_1 int_{t-1} + u_t,$$

$$int_t = \gamma_0 + \overset{>0}{\gamma_1}(gGDP_{t-1} - 3) + v_t.$$

Given $\gamma_1 > 0$, u_t uncorrelated with int_t, int_{t-1} and v_t uncorrelated with past values of int_t and u_t, show that $Cov(int_t, u_{t-1}) \neq 0$. Which assumption is violated?

$$int_t = \gamma_0 + \gamma_1 [\alpha_0 + \delta_0 int_{t-1} + \delta_1 int_{t-2} + u_{t-1} - 3] + v_t$$

$$= \gamma_0 + \gamma_1 \alpha_0 + \gamma_1 \delta_0 int_{t-1} + \gamma_1 \delta_1 int_{t-2} + \gamma_1 u_{t-1} - 3\gamma_1 + v_t$$

$$Cov(int_t, u_{t-1}) = Cov(\gamma_0 + \gamma_1 \alpha_0 + \gamma_1 \delta_0 int_{t-1} + \gamma_1 \delta_1 int_{t-2} + \gamma_1 u_{t-1} - 3\gamma_1 + v_t, u_{t-1})$$

$$= \gamma_1 \, Cov(u_{t-1}, u_{t-1}) = \gamma_1 \cdot V(u_{t-1}) = \underbrace{\gamma_1}_{>0} \cdot \underbrace{\sigma^2}_{>0}$$

$\Rightarrow Cov(int_t, u_{t-1}) > 0 \Rightarrow$ No zero cond. mean violated