Elements of Econometrics. 2022-2023.

Class 19. AR, MA and Common Factor Test.

Problem 1. (Theoretical exercise). Explain why better specification could help to get rid of autocorrelation?

Problem 2. (Practice exercise). Illustrate the improving specification as tool for fighting symptoms and consequences of the autocorrelation using regression of the expenditures on cosmetics (COSM) on disposable personal income (DPI) and cosmetic prices (PCOSM and PRELCOSM) – file **EXPEND.WF1**. Use DW tables to test for autocorrelation.

Problem 3. (Theoretical exercise). Explain what is autoregressive transformation AR(1). How to apply iterative autoregressive transformation (C-O regression of GLS)?

Problem 4. (Practice exercise). Illustrate topics discussed in Problem 3 using regression of the expenditures on cosmetics (CLOT) on disposable personal income (DPI) and cosmetic prices. Use DW tables to test for autocorrelation.

Problem 5. (Theoretical exercise). What is autocorrelation of the moving average type?

Problem 6. (Theoretical exercise). What is moving average transformation MA(1)? How it works in case of MA(1) type of autocorrelation?

Problem 7. (Practical exercise). Illustrate using moving average transformation MA(1) and combined AR(1) and MA(1) approach to fight with autocorrelation using regressions mentioned above.

Problem 8 . (Theoretical exercise). Explain how including lagged dependent variable ADL(1,0) could help in case of autocorrelation.

Problem 9. (Practical exercise). Illustrate topics in problem 8. Use h-test for autocorrelation.

Problem 10. (Theoretical exercise). Explain how ADL(1,1) model could help in case of autocorrelation. How it is connected with Common Factor Test?

Problem 11. (Practical exercise). Illustrate Common Factor Test for simple linear regression

Problem 12. (Practical exercise). Illustrate Common Factor Test for multiple linear regression

Real Problems from London and ICEF exams

Problem 13. (UoL Exam). Describe the Cochrane-Orcutt procedure in detail. Should the Cochrane-Orcutt procedure always be used when a statistical test establishes that serial correlation is present in the residuals of a least squares regression?

Problem 14. (UoL Exam))
Denoting aggregate consumer expenditure on personal business services *y*, aggregate disposable personal income *x*, and a relative price index for personal business services *p*, the following regressions were fitted using annual data for the United States for the period 1959-1994 (standard errors in parentheses):

(1) *OLS*

$$\hat{\log} y_t = -1.5 + 1.17 \log x_t - 0.59 \log p_t \quad R^2 = 0.985 \;\; d = 0.85$$
$$(0.9) \;\; (0.15) \qquad (0.13) \qquad\qquad RSS = 0.0242$$

(2) *C-O*

$$\hat{\log} y_t = -3.2 + 0.93 \log x_t + 0.14 \log p_t \quad R^2 = 0.990 \quad d = 1.86$$
$$(1.1) \;\; (0.15) \qquad (0.15) \qquad\qquad RSS = 0.0146$$

(3) *OLS*

$$\hat{\log} y_t = 0.2 + 0.74 \log y_{t-1} + 0.36 \log x_t + 0.05 \log x_{t-1} - 0.17 \log p_t - 0.27 \log p_{t-1} \quad R^2 = 0.995, d = 2.11$$
$$(0.8) \;\; (0.12) \qquad (0.22) \qquad (0.26) \qquad (0.23) \qquad (0.24) \qquad\qquad RSS = 0.0101$$

where $OLS =$ ordinary least squares, $C-O=$ Cochrane-Orcutt, $RSS =$ residual sum of squares, $d =$ Durbin-Watson statistic, *y* and *x* are measured in US \$ billions at 1992 constant prices, and *p* is a price index with 1992 $= 100$.

(a) Perform appropriate statistical tests to determine the adequacy of the specification of the first equation and give interpretations to its parameters.

(b) Perform appropriate statistical tests to determine the adequacy of the specification of the second model, present it explicitly and explain how it was estimated.

(c) Compare third and second specifications using Common Factor Test. State null hypothesis and conclusion, and give interpretation to the coefficient of $\log y_{t-1}$.

Problem 14. (ICEF Exam)
Consider a regression model

$$Y_t = \beta_1 + \beta_2 X_t + u_t; \; t = 1, 2, ..., T$$

where $u_t = \varepsilon_t + \mu\varepsilon_{t-1}$ for all t and ε_t satisfies all reasonable assumtions $E(\varepsilon_t) = 0,$, $E(\varepsilon_t^2) = \sigma_\varepsilon^2$, $E(\varepsilon_s \varepsilon_t) = 0$ if $s \neq t$. The value of μ is supposed to be $0 < \mu < 1$.

(a) Show that this regression suffers from the autocorrelation of the moving average type.

(b) Show that using some iterative process similar iterative autoregressive transformation it is possible to get rid of autocorrelation, or at least to mitigate its consequences.