

Applied Macroeconometrics 2021

Assignment Part I “Time series econometrics”

Exercise 1. Multivariate time series modelling

Aruba is an island and a constituent country of the Netherlands in the southern Caribbean sea. Before COVID-19, about three-quarters of the Aruban gross national product was earned through tourism and related activities. Most tourists came from North America, with a market-share of 73.3%, followed by Latin America with 15.2% and Europe with 8.3%.

The spreadsheet `tourism series.xlsx` has monthly series of stay-over visitors, visitor’s nights, cruise visitors and ship calls.

- Design informative graphs of and describe patterns in the series of cruise visitors and stay-over visitors to Aruba.
- How would you proceed modelling the relationship between the two variables?

Calculate natural logarithms and apply seasonal adjustment filters, X-13 ARIMA SEATS and CAMPLET (the program and a brief manual are available at www.camplet.net; for a brief description see Abeln and Jacobs (JBCR 2019)) to the two visitors series.

- Compare outcomes for the seasonally adjusted series data.
- Do the seasonal adjustment filters produce similar seasonal patterns?

- What happens if the last year of quarterly observations is discarded in the seasonal adjustment?
- Do the seasonally adjusted data lead to changes in your modelling approach described above?

Exercise 2. Stationarity and Granger-causality

- Test both visitors series for unit roots using ADF and KPSS tests. What are your findings?
- Test the two seasonally adjusted visitors series for Granger-causality. What do you find? Do you think this outcome is plausible? Motivate your answer.

Exercise 3. VAR and VECM

Columns 2–5 and 6–9 of Table 1 show two types of impulse responses with standard deviation between brackets of the VAR model of the logs of seasonally adjusted series, with a constant and a trend and three lags.

- Which columns give orthogonalized IRs (OIRs) and which generalized IRs? What is the ordering used in the OIRs? Can you comment on the plausibility of this assumption?
- Rewrite a vector autoregressive (VAR) system with three lags in \mathbf{z}_t , which consists of two variables, as a Vector Error Correction Model.
- What are the possible outcomes and implications for the rank of the parameter matrix of \mathbf{z}_{t-1} in the Vector Error Correction Model?

Table 1: Impulse responses

Period	Response of cruise visitors:		Response of stay-over visitors:		Response of cruise visitors:		Response of stay-over visitors:	
	cruise visitors	stay-over visitors	cruise visitors	stay-over visitors	cruise visitors	stay-over visitors	cruise visitors	stay-over visitors
1	0.1600 (0.0092)	-0.0030 (0.0131)	-0.0009 (0.0039)	0.0477 (0.0028)	0.1600 (0.0092)	0.0000 (0.0000)	-0.0009 (0.0039)	0.0477 (0.0028)
2	0.0716 (0.0141)	0.0315 (0.0146)	0.0049 (0.0045)	0.0256 (0.0042)	0.0716 (0.0141)	0.0329 (0.0134)	0.0049 (0.0045)	0.0257 (0.0042)
3	0.0498 (0.0146)	0.0135 (0.0148)	0.0043 (0.0049)	0.0267 (0.0046)	0.0498 (0.0146)	0.0144 (0.0142)	0.0043 (0.0049)	0.0268 (0.0046)
4	0.0160 (0.0137)	-0.0118 (0.0100)	-0.0013 (0.0050)	0.0254 (0.0037)	0.0160 (0.0137)	0.0115 (0.0100)	-0.0013 (0.0050)	0.0253 (0.0038)
5	-0.0004 (0.0118)	-0.0155 (0.0096)	-0.0016 (0.0049)	0.0208 (0.0042)	-0.0004 (0.0118)	-0.0155 (0.0097)	-0.0016 (0.0049)	0.0208 (0.0042)
6	-0.0065 (0.0101)	-0.0209 (0.0096)	-0.0028 (0.0048)	0.0188 (0.0044)	-0.0065 (0.0101)	-0.0211 (0.0096)	-0.0028 (0.0048)	0.0188 (0.0044)
7	-0.0049 (0.0065)	-0.0203 (0.0088)	-0.0029 (0.0043)	0.0173 (0.0046)	-0.0049 (0.0065)	-0.0204 (0.0088)	-0.0029 (0.0043)	0.0173 (0.0046)
8	-0.0026 (0.0043)	-0.0177 (0.0078)	-0.0025 (0.0038)	0.0158 (0.0048)	-0.0026 (0.0043)	-0.0177 (0.0078)	-0.0025 (0.0038)	0.0158 (0.0048)
9	0.0001 (0.0037)	-0.0152 (0.0071)	-0.0021 (0.0033)	0.0148 (0.0050)	0.0001 (0.0037)	-0.0152 (0.0071)	-0.0021 (0.0033)	0.0147 (0.0050)
10	0.0015 (0.0037)	-0.0131 (0.0066)	-0.0018 (0.0030)	0.0137 (0.0051)	0.0015 (0.0037)	-0.0131 (0.0066)	-0.0018 (0.0030)	0.0137 (0.0051)

- Do the graphs of the series and the impulse responses in Table 1 suggest the existence of a long-run cointegrating relation between cruise visitors and stay-over visitors (both seasonally adjusted and in logs)?
- Carry out a co-integration test. What do you find?

Exercise 4. State Space Forms

- Write VAR(2) and MA(2) and ARMA(2,2) processes in state-space form (SSF).
- Download the seasonally adjusted U.S. real GDP series.
- (5 points) Estimate a Beveridge-Nelson trend-cycle decomposition model, assuming a unit root plus drift for the trend (τ_t), an AR(2) process for the cycle (c_t), and uncorrelated innovations (η_t, ν_t).