

Time Series Forecasting

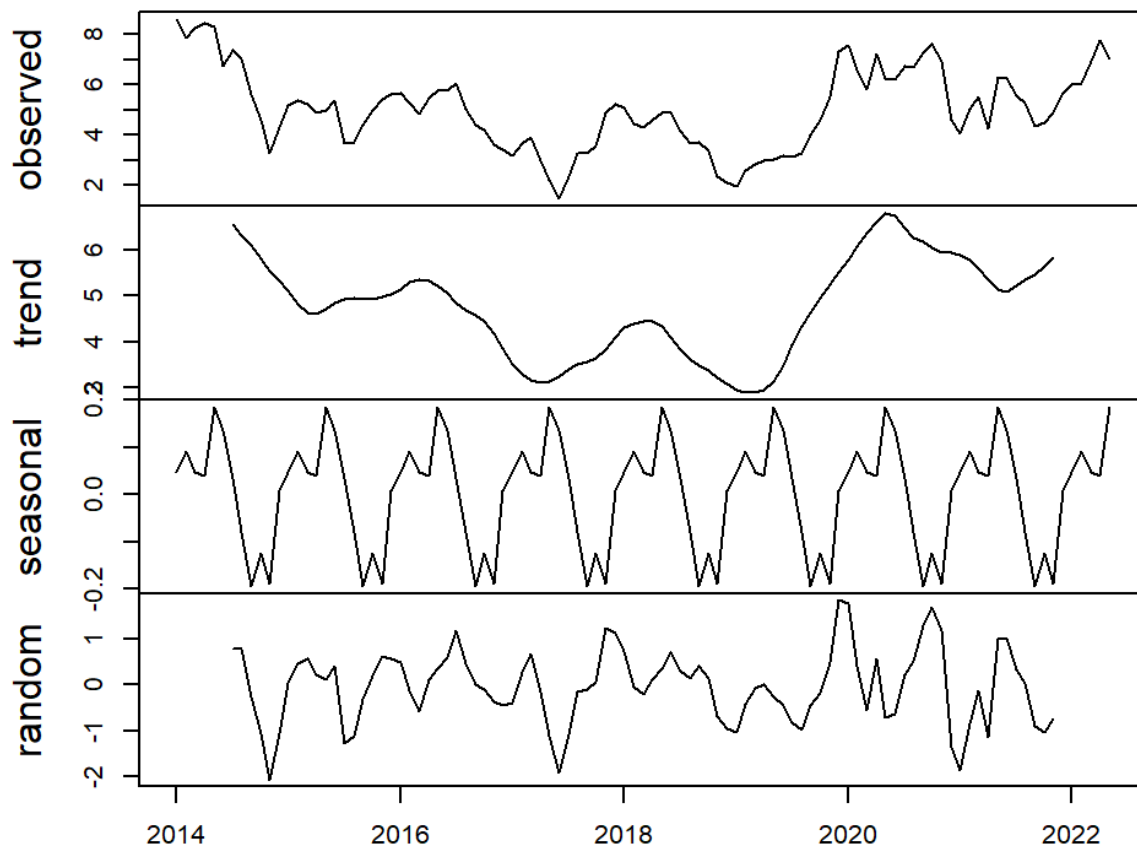
DM-473 / IB-473

Trimester IV, End-term Examinations, September 2022

SECTION A: 20 marks

Refer to the figure “Decomposition of additive time series”. The figure represents the decomposition of observed (monthly) inflation series.

### Decomposition of additive time series



**A1a** (CO1) Explain meaning of the time series components shown above. (5 marks)

OR

**A1b** (CO1) How can you find the de-seasonalised (inflation) series? Explain. (5 marks)

**A2a** (CO2) Explain the importance of visualisation with specific reference to time series data. (5 marks)

OR

**A2b** What are the uses of autocorrelation function (ACF) and partial auto-correlation function (PACF) plots in time series analysis? (CO2)

(5 marks)

**A3a** (CO3) Consider the following AR equation

$$y_t = a_1 y_{t-1} + a_2 y_{t-2} + \varepsilon_t$$

Prove that first order autocorrelation

$$\rho_1 = \frac{a_1}{1 - a_2}$$

state your assumptions. (5 marks)

OR

**A3b** (CO3) State unit root equation(s) corresponding to the ADF test. State the null and alternative hypothesis corresponding to the stated equation(s). (5 marks)

**A4a** (CO4) Forecasting horizon should be shorter. Why or why not? Provide valid reason. (5 marks)

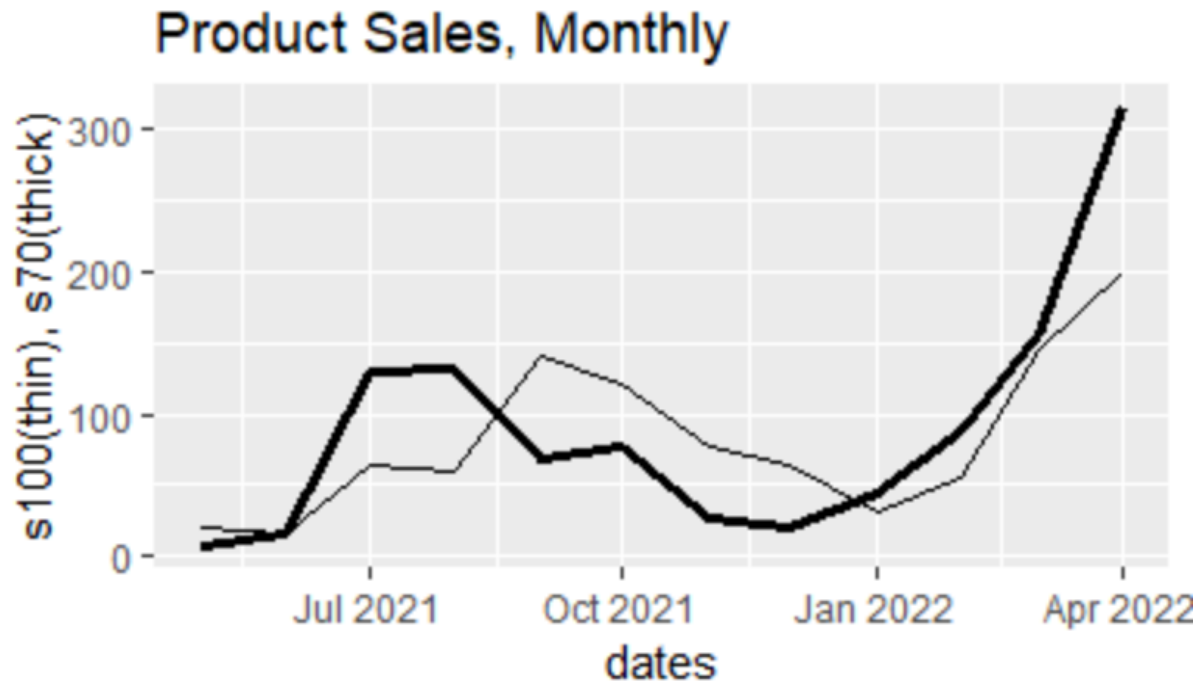
OR

**A4b** (CO4) Discuss a few ways of evaluating the forecast accuracy of any time series model or technique? (5 marks)

(Turn Over...)

**SECTION B – CASE STUDY (20 Marks)**

A plot of sales of two differentiated products of a company is given below. The products are s100 (thin line) and s70 (thick line).



An analyst finds that both series are stationary. S/he estimated the following ARIMA models.

	s70 model 1	s70 model 2	S70 model 3	s100 model 1	s100 model 2	s100 model 3
sale <sub>t-1</sub>	-0.17	0.61**	-	0.67**	0.63**	-
sale <sub>t-2</sub>	-	-	-	-	-	-
sale <sub>t-3</sub>	-	-	-	-	-	-
ε <sub>t-1</sub>	1.65***	0.62**	0.77***	-	0.17	0.81***
ε <sub>t-2</sub>	1.00**	-	-	-	1.00	-
ε <sub>t-3</sub>	-	-	-	-	-	-
Mean or constant	111.76**	121.07	99.30***	89.55	105.84**	86.77***
Observations	12	12	12	12	12	12
Log Likelihood	-66.31	-66.9	-67.81	-62.92	-61.95	-62.26
AIC	142.6	141.8	141.63	131.84	133.9	130.52

**B1.** Which ARIMA models do you think will be appropriate in explaining sales of the product s100 and s70 respectively and why? (CO 3) 10 marks

**B2.** Forecast sales (for the month 13, 14, 15) using the most appropriate model (from B1) and calculate any measure of forecast error. To be forecasted/calculated for both products. (CO 4) (10 marks)

hint: historical sales and errors are reported below.

Date	bs100	bs70	Error# (bs100)	Error# (bs70)
05-2021	20	6	-	-
06-2021	15	16	-35.11	-13.21
07-2021	65	130	18.57	89.99
08-2021	59	133	-24.16	-30.09
09-2021	140	68	61.25	-98.33
10-2021	121	76	-17.24	-20.15
11-2021	78	26	-46.28	-78.79
12-2021	65	19	-27.70	-31.80
01-2022	30	45	-53.16	1.76
02-2022	55	89	-2.45	17.68
03-2022	145	157	69.19	38.18
04-2022	199	317	57.09	124.76

#error series are obtained from a model with one lag of the respective variables.

State assumptions, if any.