Indira Gandhi National Open University
School of Sciences

Block

4

TIME SERIES MODELLING

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BLOCK 4 TIME SERIES MODELLING

In the previous block, we have discussed the fundamental concepts of regression modelling. You have learnt that regression analysis is a statistical tool for investigating and analysing the average relationship between two or more variables. We have also discussed the applications of regression analysis in decision making. In this block, we discuss time series modelling, which helps us in analysing past data to forecast and plan for future. For example, suppose the Government wishes to bring in a policy to ensure low cost housing for economically weaker sections (EWS). Then it would like to know: What would the number of people in this category be in the next five years? In general, institutions, organisations, governments and even individuals take most decisions based on the situations expected in future. Planning for future is an essential aspect of decision making and managing any organisation. This requires that one should be able to forecast the future demands or trends.

For this, it is natural to use historical data of the last few years. Based on the features observed from the past data, we try to understand their role in causing variability and use them for forecasting. This is done with the help of time series modelling, which is the analysis of a collection of observations made sequentially through time to forecast future trends. We discuss basic concepts of time series modelling in the last unit of this block. It comprises four units.

In Unit 13 entitled **Trend Component Analysis**, we introduce the concept of time series. We discuss different types of time series and different components of time series along with examples. We also explain the methods of smoothing and filtering the time series data and estimation of trend by curve fitting method and curvilinear method.

When time series data do not exhibit any trend and cyclic components but reflect seasonal variations, we have to estimate the seasonal component by removing irregular components. In Unit 14 entitled **Seasonal Component Analysis**, we discuss some methods for estimating the seasonal components, namely, the simple average method, ratio to moving average and ratio to trend methods.

In Unit 15 entitled **Stationary Processes**, we describe a very important class of time series called the stationary time series. If a time series shows a particular type of non-stationarity then some simple transformation makes it stationary and we can model it. We also explain the concepts of autocovariance, autocorrelation and correlogram for a stationary time series.

In Unit 16 entitled **Time Series Models**, we discuss the Autoregressive (AR), Moving Average (MA), mixed Autoregressive Moving Average (ARMA) and Autoregressive Integrated Moving Average (ARIMA) processes. We also analyse their properties in the form of autocorrelations and discuss the fitting of suitable models to the given data.

Notations and Symbols

Y_t	:	Time series value at time t of variable of interest Y
X_t	:	t^{th} observation of the independent variable X
$\hat{Y}_t$	:	t^{th} observation of the fitted value
e_t	:	t^{th} forecast error
T_t	:	Trend component or trend effect
S_t	:	Seasonal component or seasonal effect
C_t	:	Cyclic component or cyclic effect
I_t	:	Irregular component or irregular effect
S_i	:	i^{th} seasonal index
$\bar{y}_i$	:	Average for i^{th} year, quarter or month
μ	:	Mean
a_t	:	t^{th} white noise with mean zero, variance σ_a^2
ψ_i	:	i^{th} weight
β_i	:	i^{th} constant
γ_k	:	Autocovariance at lag k
c_k	:	Autocovariance coefficient at lag k
ρ_k	:	Autocorrelation at lag k
r_k	:	Autocorrelation coefficient at lag k
B	:	Backward shift operator
ρ = a.c.f.	:	Autocorrelation function
α = p.a.c.f.	:	Partial autocorrelation function
MA(q)	:	Moving Average process of order q
AR (p)	:	Autoregressive process of order p
ARMA(p, q)	:	Autoregressive Moving Average process of order (p, q)
ARIMA(p, d, q)	:	Autoregressive Integrated Moving Average process of order (p, q) with d differences
$\{Y(t)\}=Y_t$	:	Descrete time random process
V{Y(t)}	:	Variance of time dependent random variable Y
Sec.	:	Section/subsection
Secs.	:	Sections/subsections
Fig.	:	Figure
Figs.	:	Figures