LECTURE 2
MOVING AVERAGES AND EXPONENTIAL SMOOTHING

OVERVIEW

This lecture introduces time-series smoothing forecasting methods. Various models are discussed, including methods applicable to nonstationary and seasonal time-series data. These models are viewed as classical time-series model; all of them are univariate.

LEARNING OBJECTIVES

- Moving averages
- Forecasting using exponential smoothing
- Accounting for data trend using Holt's smoothing
- Accounting for data seasonality using Winter's smoothing
- Adaptive-response-rate single exponential smoothing

1. Forecasting with Moving Averages

The naive method discussed in Lecture 1 uses the most recent observations to forecast future values. That is, $\hat{Y}_{t+1} = Y_t$. Since the outcomes of Y_t are subject to variations, using the mean value is considered an alternative method of forecasting. In order to keep forecasts updated, a simple moving-average method has been widely used.

1.1. The Model

Moving averages are developed based on an average of weighted observations, which tends to smooth out short-term irregularity in the data series. They are useful if the data series remains fairly steady over time.

Notations

$M_t \equiv \hat{Y}_{t+1}$ - Moving average at time t, which is the forecast value at time $t+1$,

Y_t - Observation at time t,

$e_t = Y_t - \hat{Y}_t$ - Forecast error.

A moving average is obtained by calculating the mean for a specified set of values and then using it to forecast the next period. That is,

$$M_t = (Y_t + Y_{t-1} + \cdots + Y_{t-n+1})/n \qquad (1.1.1)$$

$$M_{t-1} = (Y_{t-1} + Y_{t-2} + \cdots + Y_{t-n})/n \qquad (1.1.2)$$