

ARMA & ARIMA



ARMA

Combines AR and MA components for stationary series

ARMA (p, q)



ARIMA

Adds differencing for non-stationary series

ARIMA (p, d, q)



Seasonal ARIMA (SARIMA)

Extended version for modeling periodic patterns and seasonality



Methodology

Box-Jenkins for model identification



Applications

Widely used in econometrics & forecasting



Trend Calculation Example



선형 트렌드 추정 (Linear Trend Estimation)

Time (t)	1	2	3	4	5
Observed (Y_t)	10	12	15	17	20

1 Trend Model

$$Y_t = \beta_0 + \beta_1 \cdot t + \varepsilon_t$$

2 Coefficient Estimation using OLS

$$\beta_1 = \Sigma [(t - \bar{t})(Y_t - \bar{Y})] / \Sigma (t - \bar{t})^2$$

$$\beta_0 = \bar{Y} - \beta_1 \cdot \bar{t}$$

$\beta_1 = 2.5$ (Slope) | $\beta_0 = 7.5$ (Intercept)

3 Final Trend Equation

$$\hat{Y}_t = 7.5 + 2.5 \cdot t$$



Linear Trend

Constant rate of increase/decrease



Nonlinear Trend

Polynomial of degree 2 or higher



Exponential Trend

Exponential growth/decay



Differencing Method

Differencing to remove trend

4 Forecasting with Trend Model

Using the estimated equation: $\hat{Y}_t = 7.5 + 2.5 \cdot t$

Forecast for $t = 6$:

$$\hat{Y}_6 = 7.5 + 2.5 \times 6 = 22.5$$

Forecast for $t = 7$:

$$\hat{Y}_7 = 7.5 + 2.5 \times 7 = 25.0$$

Forecast for $t = 8$:

$$\hat{Y}_8 = 7.5 + 2.5 \times 8 = 27.5$$



Forecast Limitation

Long-term forecasts become less reliable



Best Practice

Check model assumptions and residuals