ARMA Analysis

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By definition, auto-regressive moving average (ARMA) is a stationary stochastic process made up of sums of auto-regressive Excel and moving average components.

Alternatively, in a simple formulation for an ARMA(p,q):

$$ x_t -\phi_o - \phi_1 x_{t-1}-\phi_2 x_{t-2}-\cdots -\phi_p x_{t-p}=a_t + \theta_1 a_{t-1} + \theta_2 a_{t-2} + \cdots + \theta_q a_{t-q}$$

where:

- x_t is the observed output at time t.
- a_t is the innovation, shock or error term at time t.
- p is the order of the last lagged variables.
- q is the order of the last lagged innovation or shock.
- $\{a_t\}$ time series observations are independent and identically distributed (i.e. i.i.d) and follow a Gaussian distribution (i.e. $\Phi(0,\sigma^2)$

Using back-shift notations (i.e. L), we can express the ARMA process as follows:

$$(1-\phi_1 L - \phi_2 L^2 -\cdots - \phi_p L^p) x_t - \phi_o= (1+\theta_1 L+\theta_2 L^2 + \cdots + \theta_q L^q)a_t$$

Assuming y_t is stationary with a long-run mean of μ, then taking the expectation from both sides, we can express ϕ_o as follows:

$$ \phi_o = (1-\phi_1 -\phi_2 - \cdots - \phi_p)\mu $$

Thus, the ARMA(p,q) process can now be expressed as

$$(1-\phi_1 L - \phi_2 L^2 -\cdots - \phi_p L^p) (x_t - \mu)= (1+\theta_1 L+\theta_2 L^2 + \cdots + \theta_q L^q)a_t$$ $$z_t = x_t - \mu$$ $$(1-\phi_1 L - \phi_2 L^2 -\cdots - \phi_p L^p) z_t = (1+\theta_1 L+\theta_2 L^2 + \cdots + \theta_q L^q)a_t$$

In sum, z_t is the original signal after we subtract its long-run average.

Remarks

1. The variance of the shocks is constant or time-invariant.
2. The order of an AR component process is solely determined by the order of the last lagged auto-regressive variable with a non-zero coefficient (i.e. w_{t-p}).
3. The order of an MA component process is solely determined by the order of the last moving average variable with a non-zero coefficient (i.e. a_{t-q}).
4. In principle, you can have fewer parameters than the orders of the model.
5. **Example:** Consider the following ARMA(12,2) process: \[(1-\phi_1 L -\phi_{12} L^{12}

)(y_t - \mu) = (1+\theta L^2)a_t\]

Requirements

Header	SFSDK.H
Library	SFSDK.LIB
DLL	SFSDK.DLL

References

Hamilton, J .D.; Time Series Analysis , Princeton University Press (1994), ISBN 0-691-04289-6

Tsay, Ruey S.; Analysis of Financial Time Series John Wiley & SONS. (2005), ISBN 0-471-690740

See Also

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