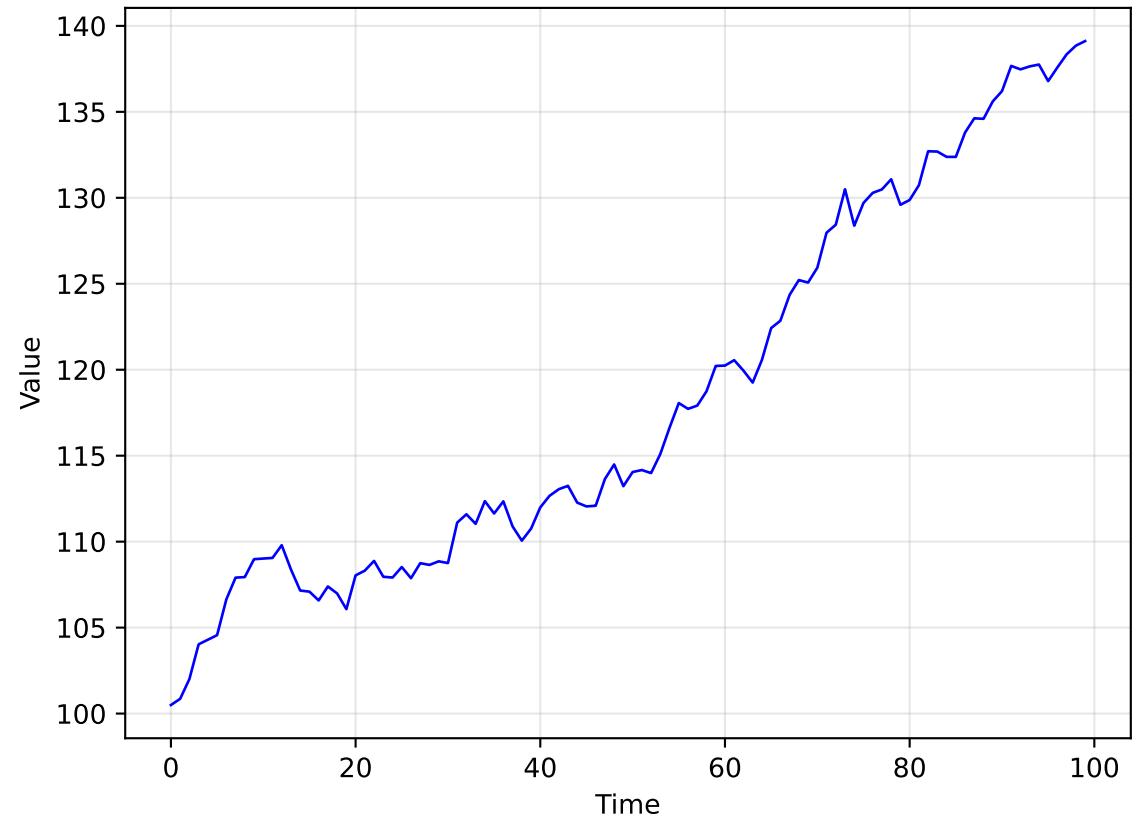
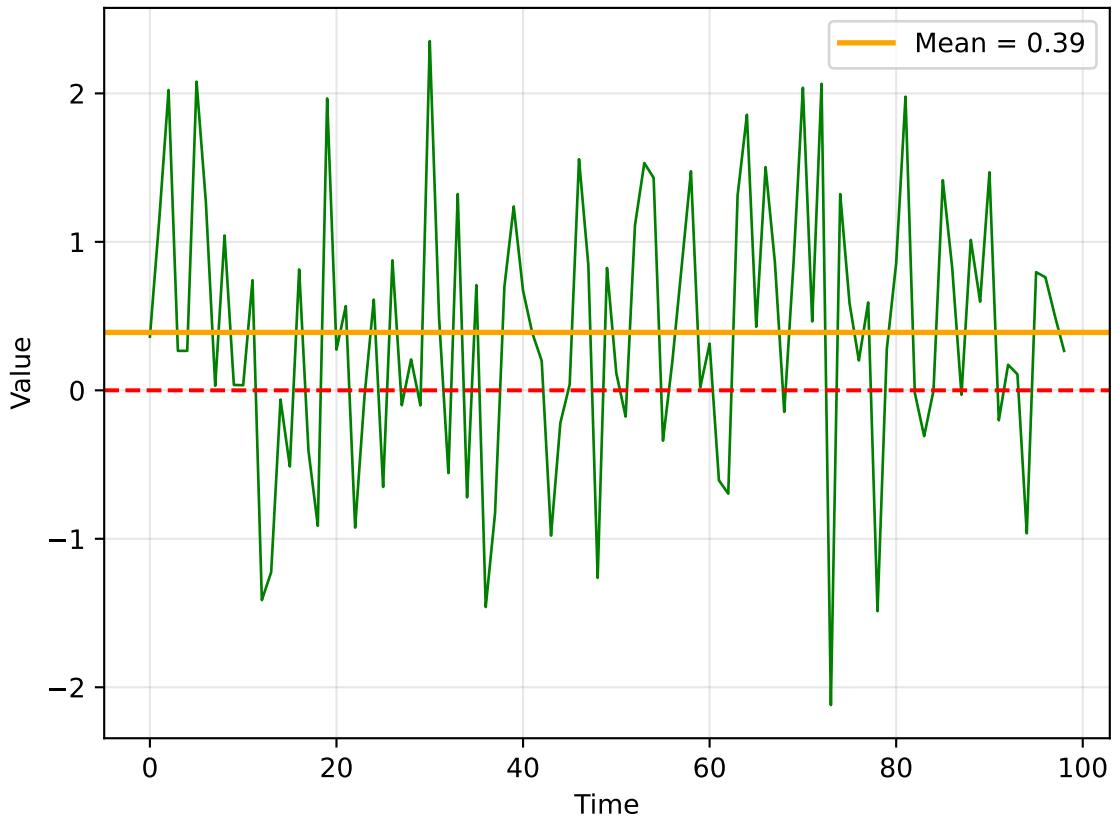


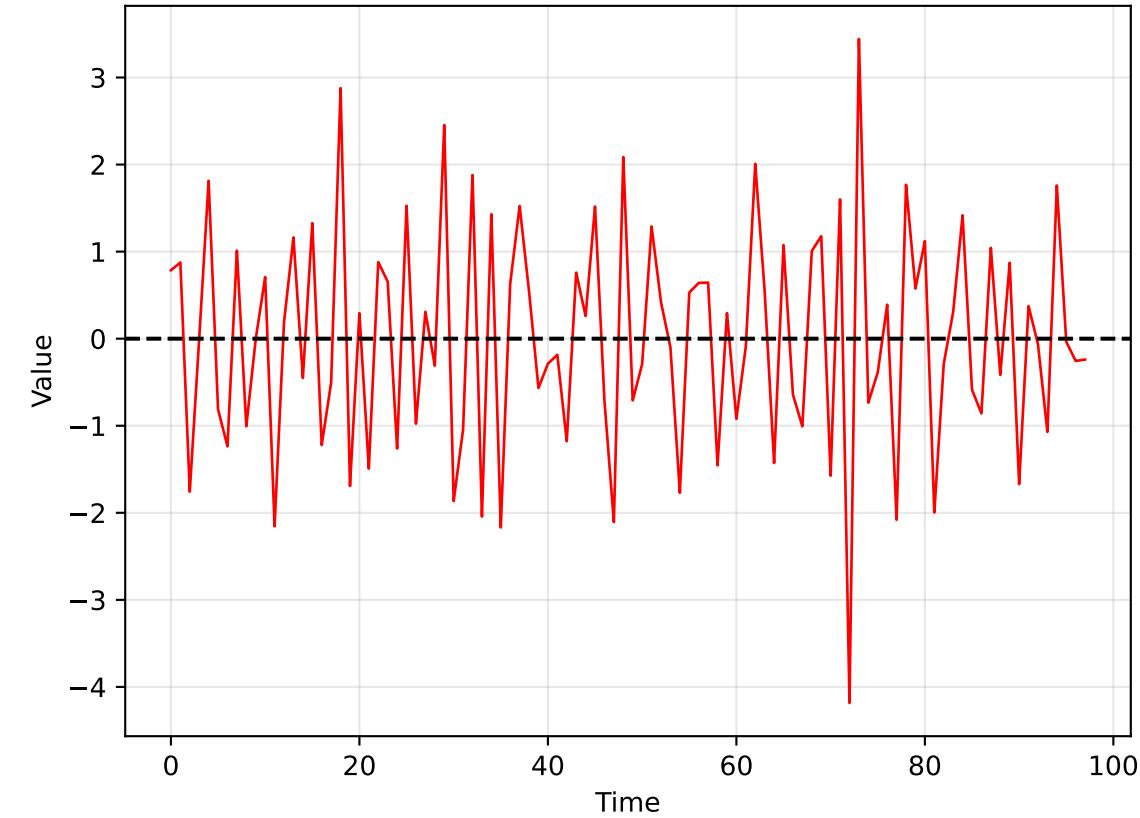
Original Series X_t



First Difference $\Delta X_t = (1 - L)X_t$



Second Difference $\Delta^2 X_t = (1 - L)^2 X_t$



Lag Operator Summary

Notation:

$$L X_t = X_{t-1} \quad (\text{one lag})$$
$$L^k X_t = X_{t-k} \quad (k \text{ lags})$$

Difference Operator:

$$\Delta = (1 - L)$$
$$\Delta X_t = X_t - X_{t-1}$$

Second Difference:

$$\Delta^2 = (1 - L)^2 = 1 - 2L + L^2$$
$$\Delta^2 X_t = X_t - 2X_{t-1} + X_{t-2}$$

AR(p) in Lag Notation:

$$\phi(L)X_t = \varepsilon_t$$
$$\text{where } \phi(L) = 1 - \phi_1 L - \phi_2 L^2 - \dots - \phi_p L^p$$

MA(q) in Lag Notation:

$$X_t = \theta(L)\varepsilon_t$$
$$\text{where } \theta(L) = 1 + \theta_1 L + \theta_2 L^2 + \dots + \theta_q L^q$$

ARMA(p, q):

$$\phi(L)X_t = \theta(L)\varepsilon_t$$