Some notations and formulas - Chapter 1

\[ t : \text{time}, \ t \in T_0, \ e.g. \ T_0 = \{0, \pm 1, \pm 2, \ldots\} \]  
(1)

\[ \{x_t\} : \text{time series data} \]  
(2)

\[ \{X_t\} : \text{time series model} \]  
(3)

\[ F_t(x) = \text{Prob}[X_t \leq x] : \text{marginal distribution} \]  
(4)

\[ P[X_1 \leq x_1, \ X_2 \leq x_2, \ldots] : \text{joint distribution} \]  
(5)

\[ X_t = 1 \text{ or } 0 : \text{binary time series} \]  
(6)

\[ \mu_X(t) = E(X_t) \]  
(7)

\[ \gamma_X(r, s) = \text{Cov}(X_r, X_s) \]  
(8)

Weakly stationary case.

\[ \mu_X = E(X_t) \]  
(9)

\[ \gamma_X(h) = \text{cov}(X_{t+h}, X_t), \ h : \text{lag}, \ ACVF \]  
(10)

\[ \rho_X(h) = \text{Cor}(X_{t+h}, X_t), \ ACF \]  
(11)

IID(0, \sigma^2), \ WN(0, \sigma^2)

MA(1):

\[ X_t = Z_t + \theta Z_{t-1}, \ \{Z_t\} \sim WN(0, \sigma^2) \]  
(12)

AR(1):

\[ X_t = \phi X_{t-1} + Z_t, \ \{Z_t\} \sim WN(0, \sigma^2), \ |\phi| < 1 \]  
(13)

\[ \bar{x} : \text{sample mean}, \ n^{-1} \sum_{t=1}^{n} x_t \]  
(14)

\[ \hat{\gamma}(h) : \text{sample ACVF}, \ n^{-1} \sum_{1 \leq t, t+h \leq n} (x_{t+h} - \bar{x})(x_t - \bar{x}) \]  
(15)

\[ \hat{\rho}(h) : \text{sample ACF}, \ \hat{\gamma}(h)/\hat{\gamma}(0) \]  
(16)

Classical decomposition model.

\[ X_t = m_t + s_t + Y_t, \ \{Y_t\} \sim IID(0, \sigma^2) \]  
(17)

\[ m_t : \text{trend} \quad s_t, \ (s_{t+d} = s_t, \ \sum_{j=1}^{d} s_j = 0) : \text{seasonal} \]  
(18)