Some notations and formulas - Chapter 1

$$t: \ time, \ t \ \in \ T_0, \ e.g. \ T_0 \ = \ \{0, \pm 1, \pm 2, ...\} \tag{1}$$

$$\{x_t\}: \ time \ series \ data \tag{2}$$

$$\{X_t\}: \ time \ series \ model \tag{3}$$

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

$$P[X_1 \leq x_1, \ X_2 \leq x_2, ...]: \ joint \ distribution \tag{5}$$

$$X_t \ = \ 1 \ or \ 0: \ binary \ time \ series \tag{6}$$

$$\mu_X(t) \ = \ E(X_t) \tag{7}$$

$$\gamma_X(r,s) \ = \ Cov(X_r, X_s) \tag{8}$$

Weakly stationary case.

$$\mu_X \ = \ E(X_t) \tag{9}$$

$$\gamma_X(h) \ = \ cov(X_{t+h}, X_t), \quad h: lag, \quad ACVF \tag{10}$$

$$\rho_X(h) \ = \ Cor(X_{t+h}, X_t), \quad ACF \tag{11}$$

$IID(0, \sigma^2)$, $\qquad WN(0, \sigma^2)$
$MA(1)$:

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

$AR(1)$:

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

$$\bar{x}: \ sample \ mean, \quad n^{-1} \sum_{t=1}^{n} x_t \tag{14}$$

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

$$\hat{\rho}(h): \ sample \ ACF, \quad \hat{\gamma}(h)/\hat{\gamma}(0) \tag{16}$$

Classical decomposition model.

$$X_t \ = \ m_t + s_t + Y_t, \quad \{Y_t\} \ \sim \ IID(0, \sigma^2) \tag{17}$$

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