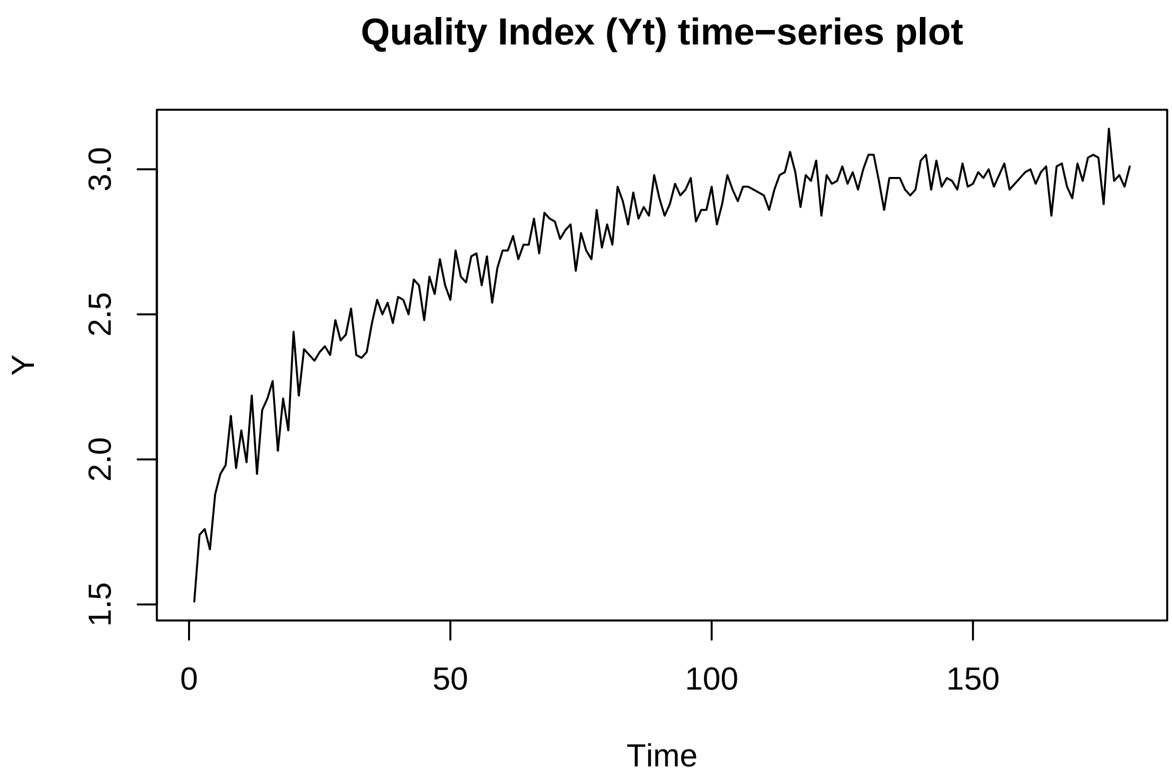
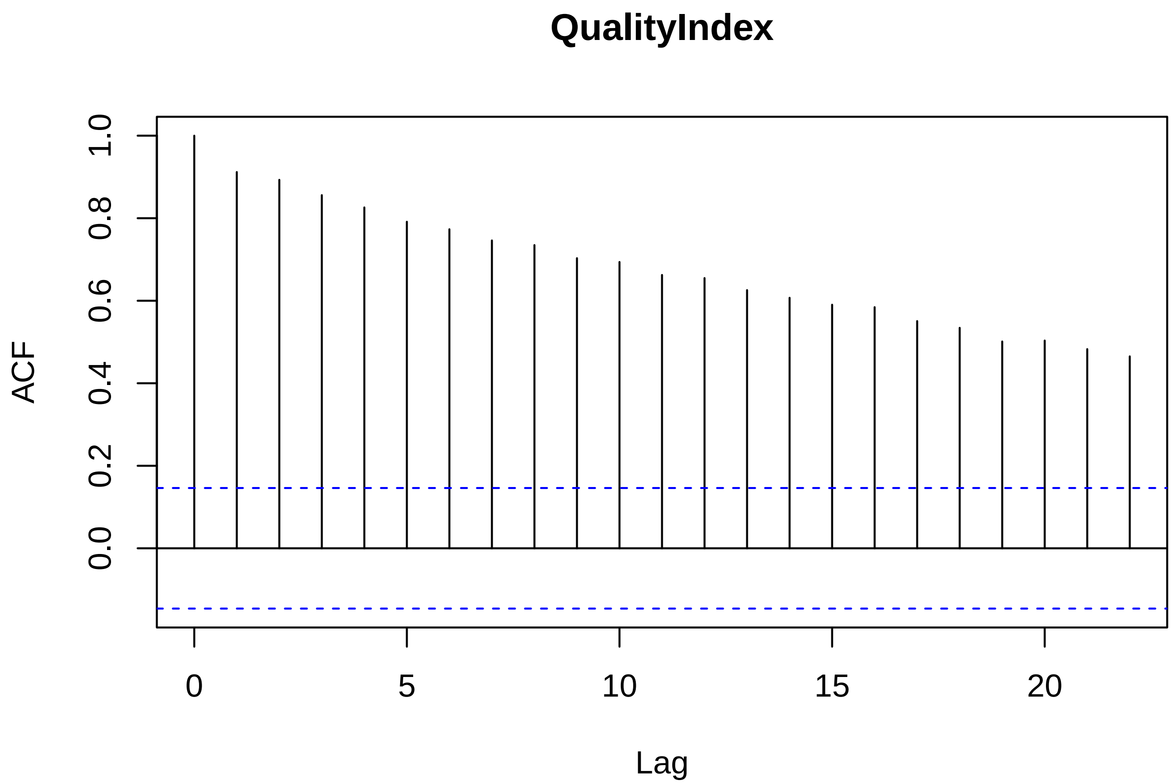
Q1

a)

```
data <- read.csv("Quality.csv")
Y <- ts(data)
ts.plot(Y, main = "Quality Index (Yt) time-series plot")
```




```
acf(Y)
```



Comments

A weakly stationary process $(Y_t)_{t=0,\dots,T}$ satisfies three conditions: constant mean over t, $E(|Y_t|) < \infty$, and the acvf satisfies $\gamma(r, s) = \gamma(r + s, s + t) \forall r, s, r + t, s + t \in T$.

- Using the ACF, we conclude the realizatons of Y_t do NOT come from a stationary process because:
  - The ACF exibits slow decay as the lag (h) increases indicating a trend and thus non-constant mean.
  - ACF will show period if substantial deterministic periodic trend. No period discrenible from ACF. It might by small.
  - ACF used for checking if the residuals of a regression are correlated.
  - All peaks on the ACF are outside critical strip so the third condition of constant covariance over fixed time intervals is not satisfied.
- What potential components of an additive classical decomposition model $Y_t = m_t + S_t + R_t$ do you propose to model this data?
  - From the ACF and time series plot, the model requires a trend component m_t as the mean is not constant over time.
  - We need a stochastic component R_t to account for random noise as well, as seen in the peaks of the time-series plot.
  - We may NOT need a seasonality component S_t since there is no discernible periodic pattern on the ACF.
  - So I propose $Y_t = m_t + R_t$

b)

```
test_indx = c(5, 14, 29, 30, 36, 39, 66, 71, 79, 84, 85, 96, 109,
              112, 135, 136, 139, 146, 156, 171)
plot(time(Y), Y, xlab = "Time", ylab = "Quality Index (Yt)", main = "Yt points")
points(test_indx, Y[test_indx], col = "green")
legend("bottomright", legend = c("Test set", "Training set"), col=c("green", "black"), pch = 16)
```