1. True

2. The problem of over-fitting will lead to the loss of valuable information & trend, making it difficult to forecast the future inaccuartely (Source: Forecasting: principles and practice (2018) Hyndman, R.J. & Athanasopoulos)

2. **In this question you will become acquainted with the relationship between** $ARIMA$ **models and** $ARMA$ **models**: in general, an $ARIMA(p, d, q)$ can be represented as a non-stationary $ARMA(p + d, q)$ model.

- Consider the $ARIMA(1, 1, 1)$ model given by

$$(1 - \phi B)(1 - B)Y_t = (1 + \theta B)\epsilon_t$$

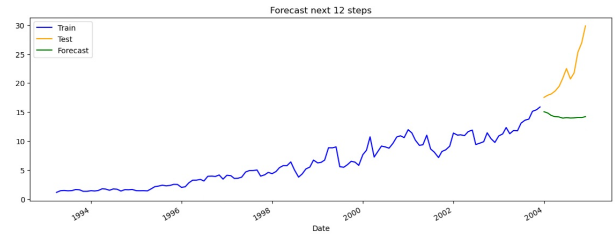
by expanding the backward shift operator notation show that this $ARIMA(1, 1, 1)$ model can be represented as a non-stationary $ARMA(2, 1)$ model. No need to show non-stationary, just show the order matches.

$$(1 - B - \phi B - \phi B^2) Y_t = (1 + \theta B)\epsilon_t$$

$$Y_t = \underbrace{(B + \phi B)Y_t + \phi B^2 Y_t}_{AR(2)} + \underbrace{(1 + \theta B)\epsilon_t}_{MA(1)}$$

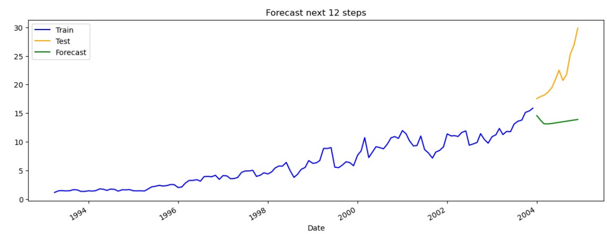
3. (a) choose d=1 since by adf_test it's stationary

RMSE = 8.3622 , ARMA(3,3)



(b) Model: ARIMA((1,0,2), trend='ct')

RMSE = 8.8554



(c) They are not the same. It doesn't have trend in (a) model, and the order is different when including trend.