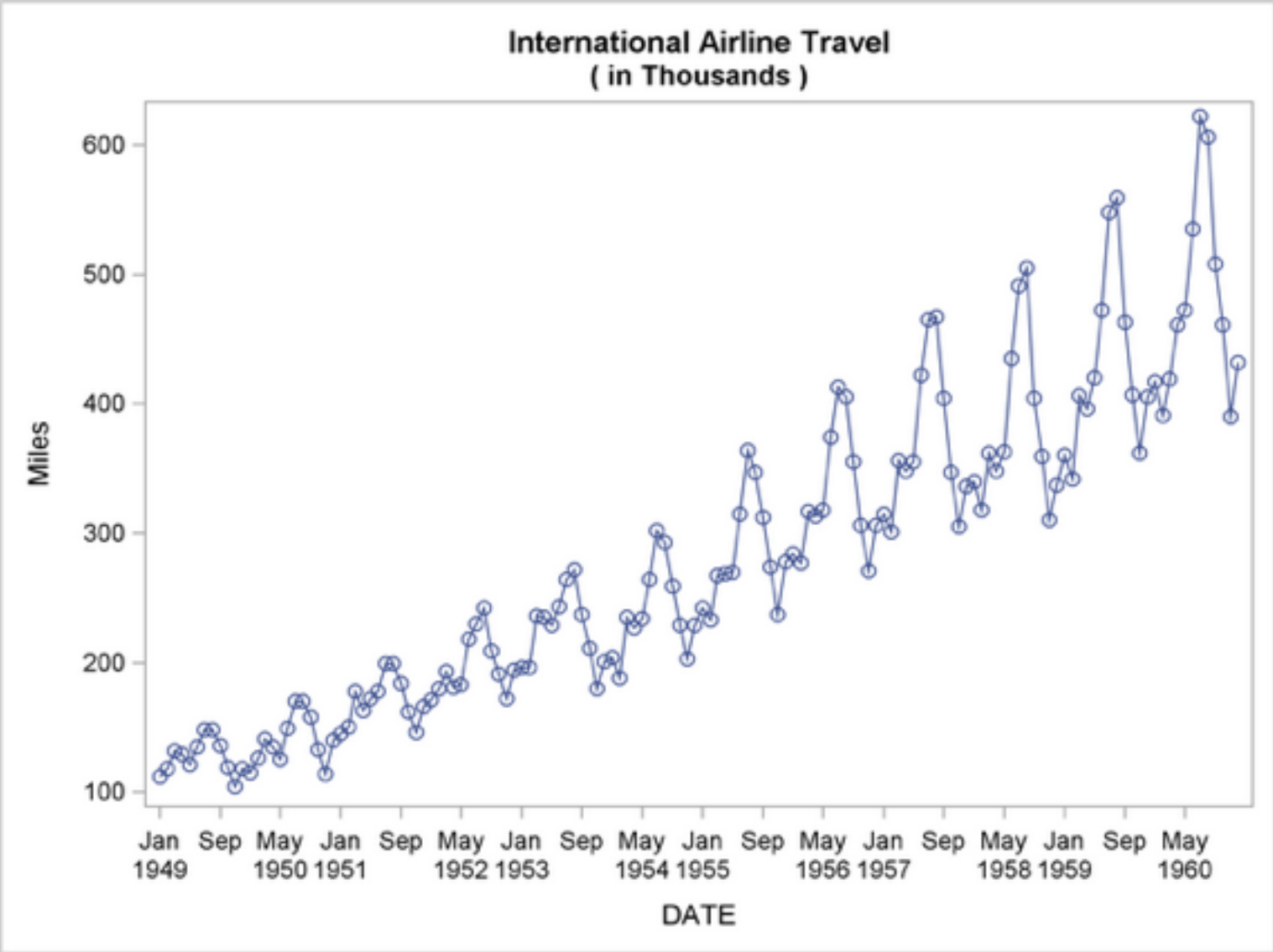
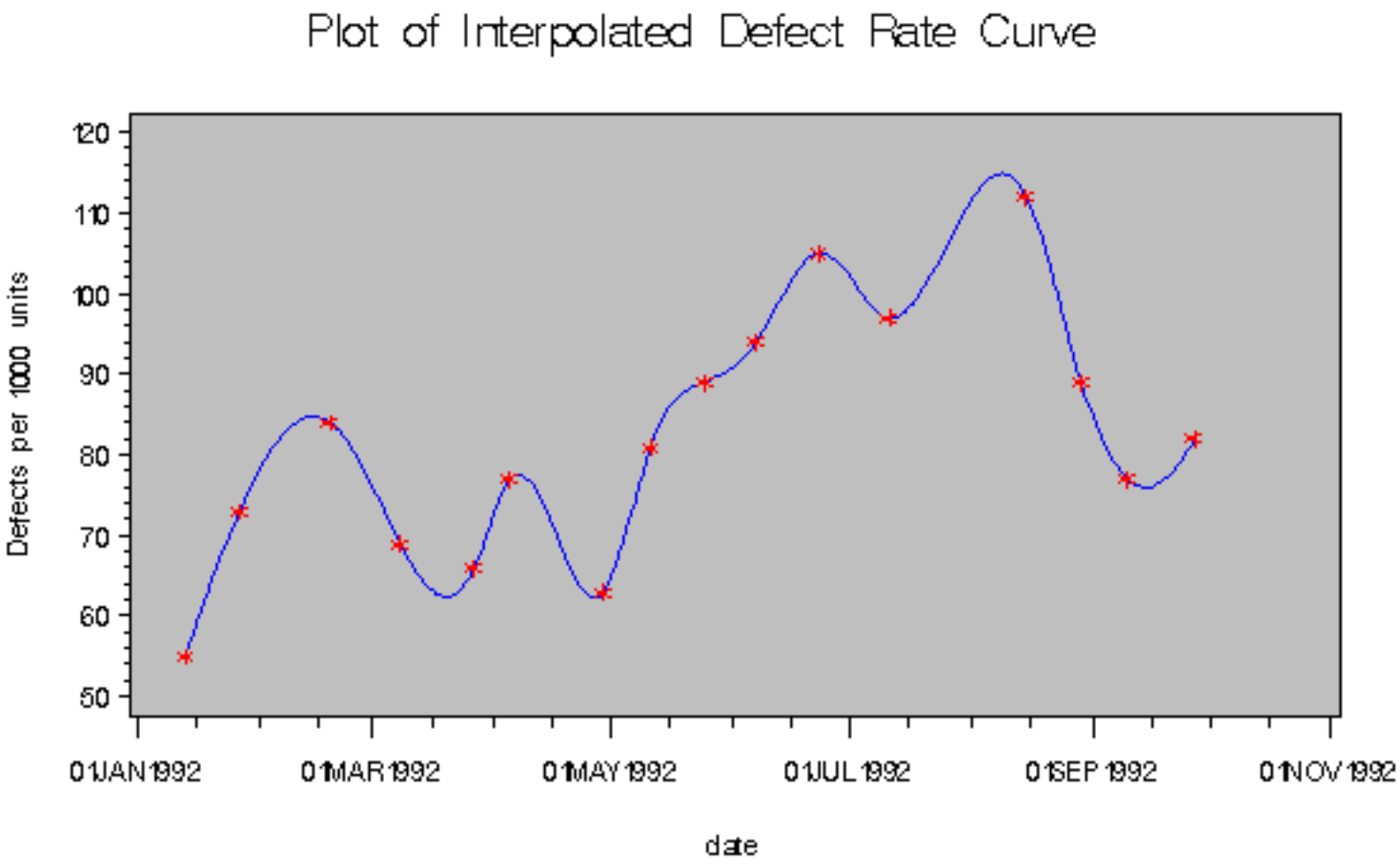
Time Series Analysis

Time Series Data

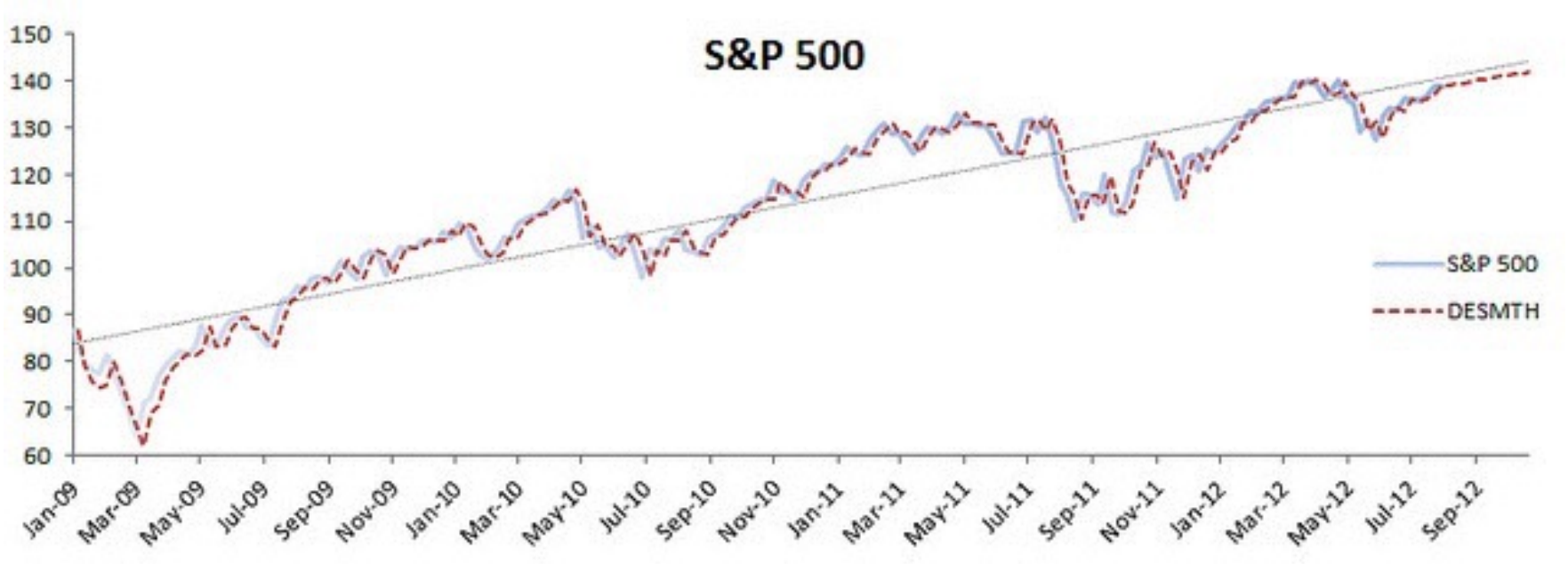
International Airline Travel



Defect Rate Vs Time

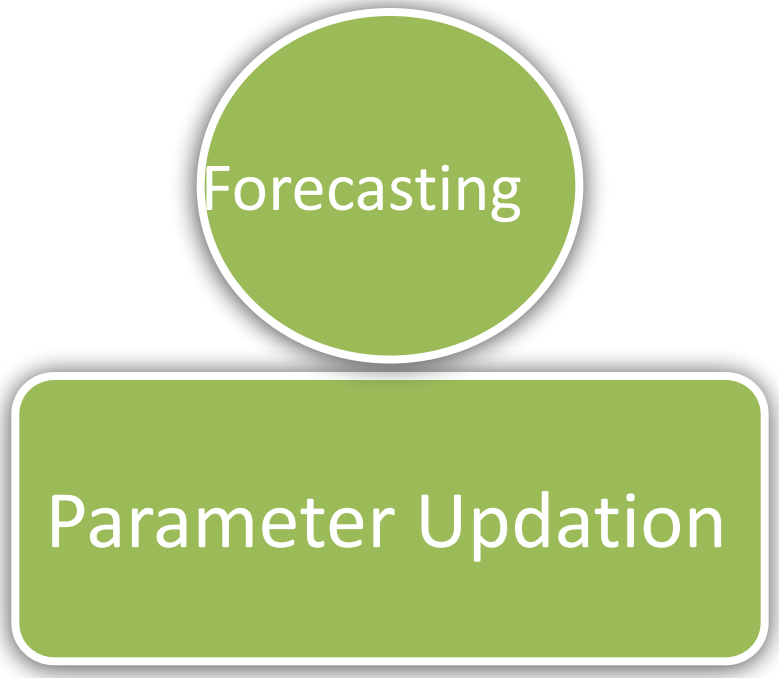


Stock Prices

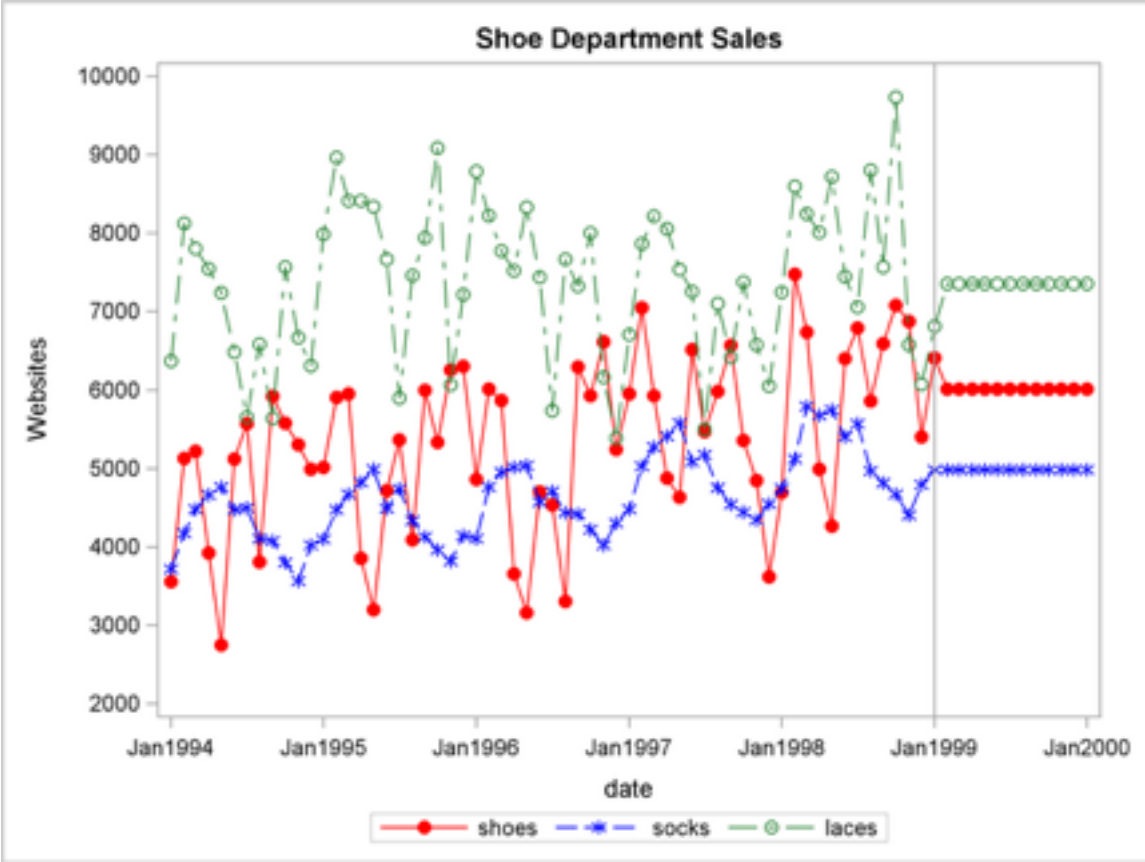


Exponential Smoothing

Two Parts

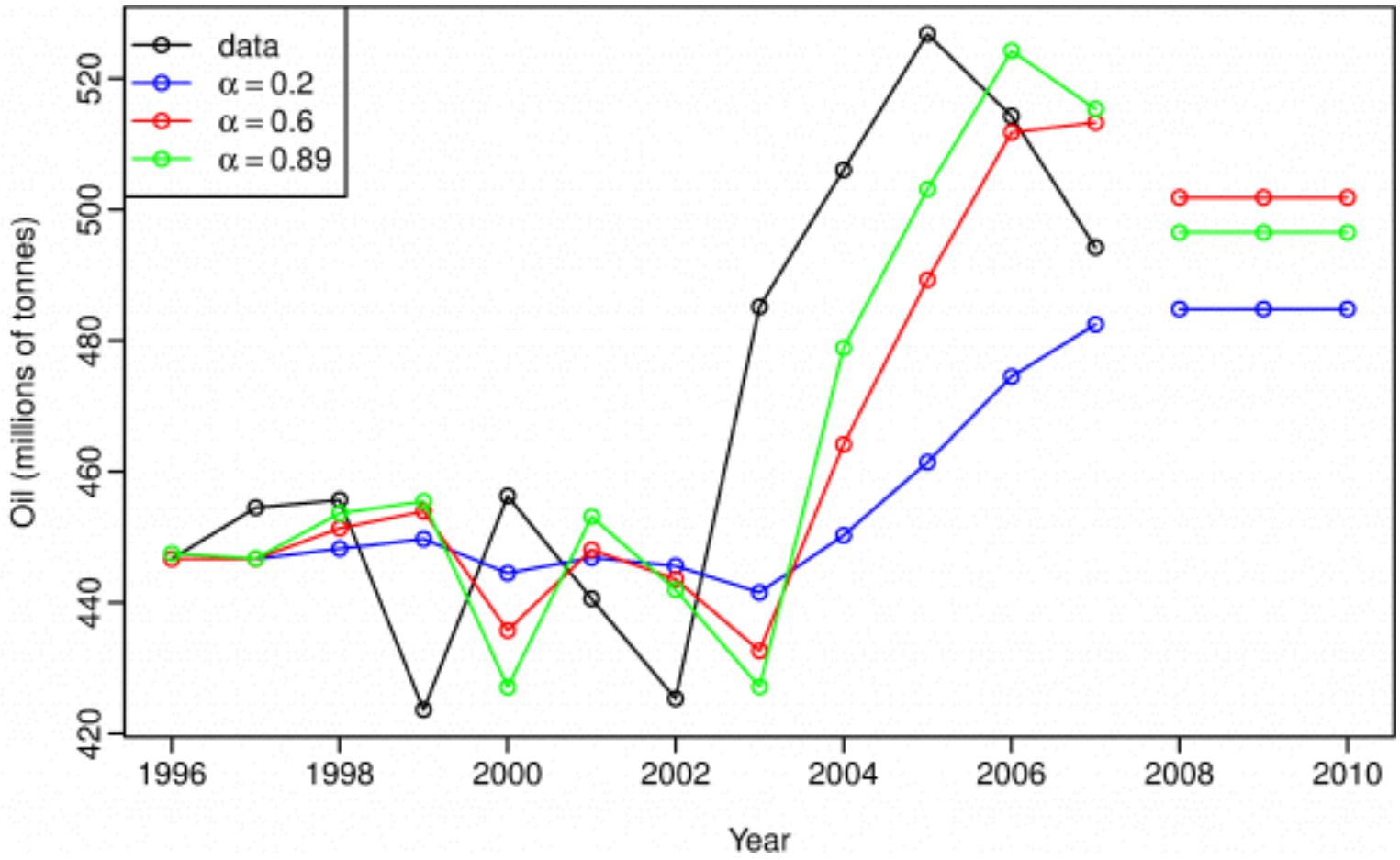


Forecasting Model: Level



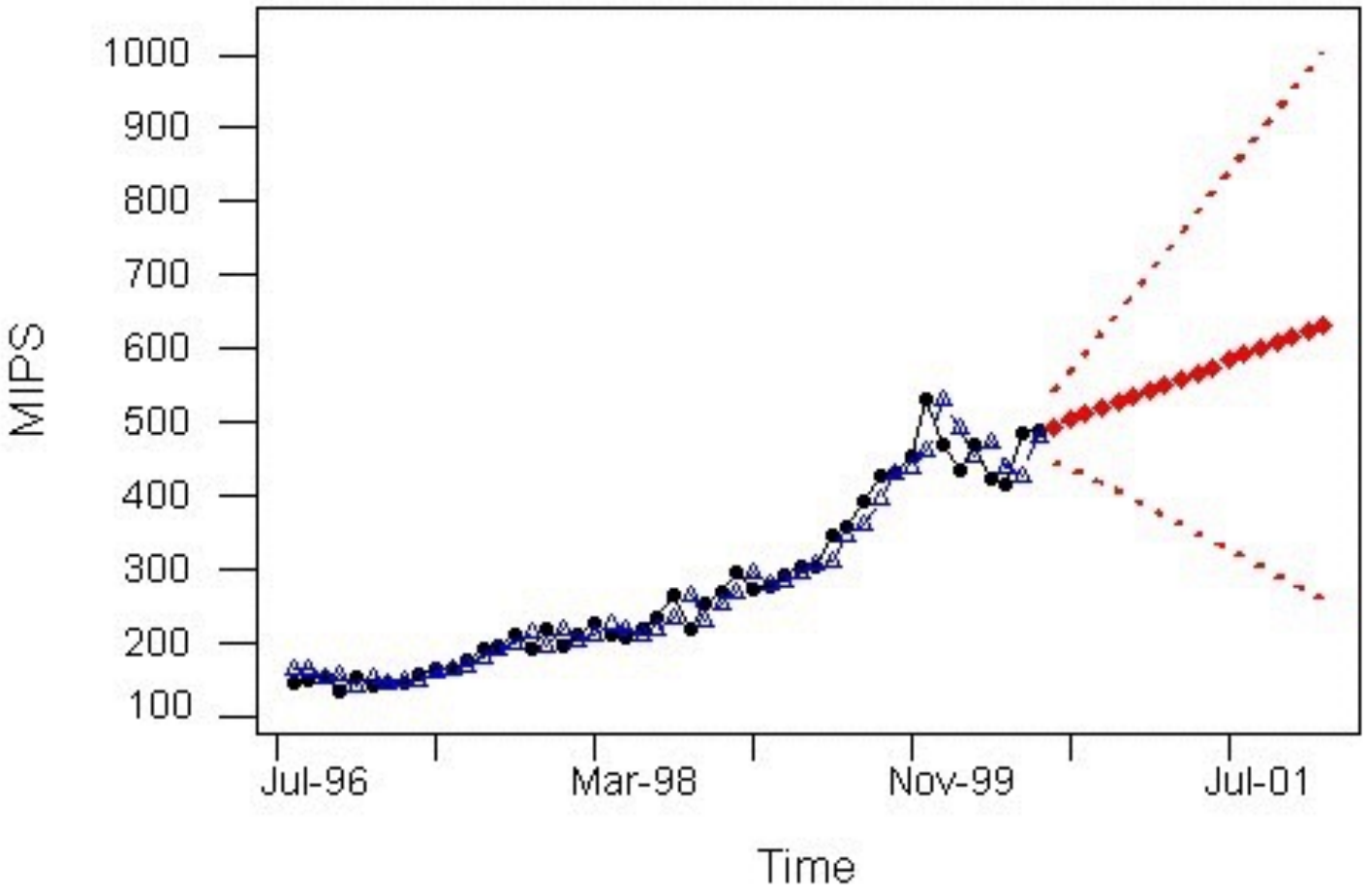
$$\hat{y}_{t+1|t} = l_t + \epsilon_t$$

Parameter Updation : Level



$$l_t = \alpha * y_t + (1 - \alpha) * l_{t-1}$$

Forecasting Model : Trend



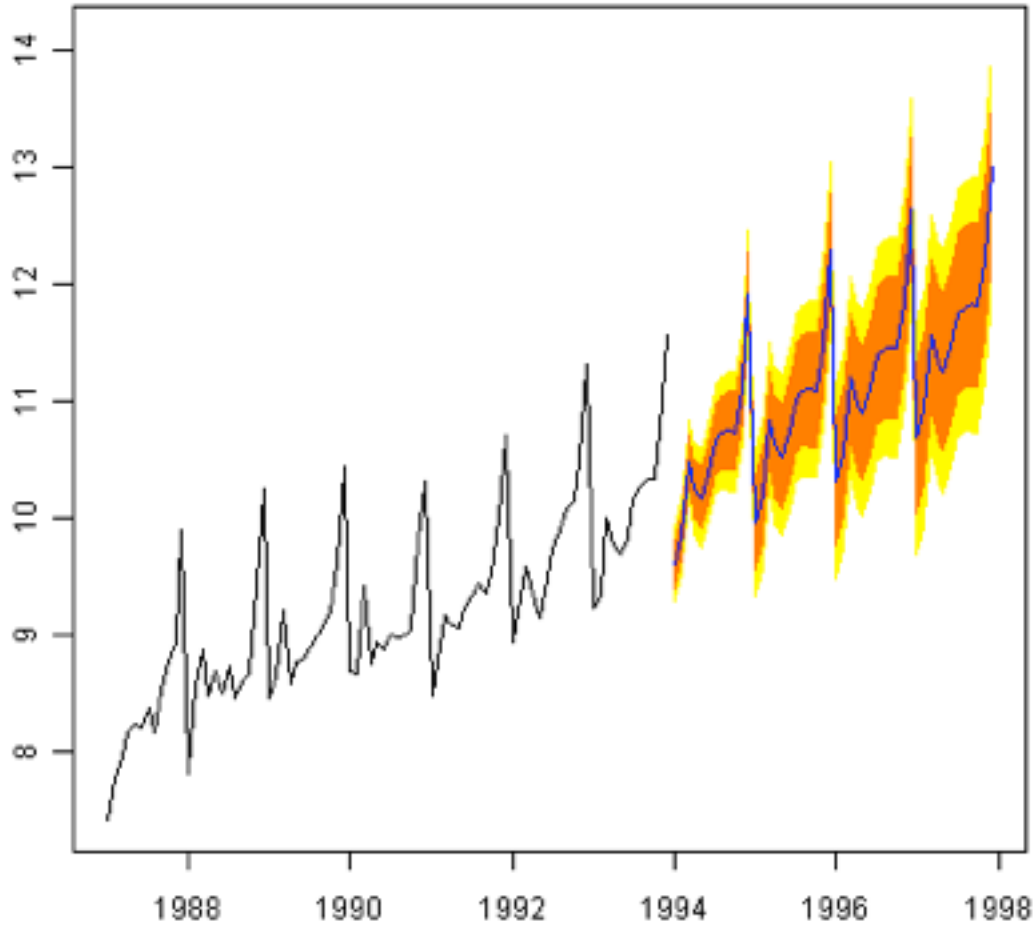
$$\hat{y}_{t+h|t} = l_t + h * b_t$$

Parameter Updation : Trend

$$l_t = \alpha * y_t + (1 - \alpha) * (l_{t-1} + b_{t-1})$$

$$b_t = \beta * (l_t - l_{t-1}) + (1 - \beta) * b_{t-1}$$

Forecasting Model : Seasonality



$$\hat{y}_{t+h|t} = l_t + h * b_t + s_{t-m}$$

Parameter Updation : Seasonality

$$l_t = \alpha * (y_t - s_{t-m}) + (1 - \alpha) * (l_{t-1} + b_{t-1})$$

$$b_t = \beta * (l_t - l_{t-1}) + (1 - \beta) * b_{t-1}$$

$$s_t = \gamma * (y_t - l_{t-1} - b_{t-1}) + (1 - \gamma) * s_{t-m}$$

ARIMA : Auto Regressive Integrated Moving Average

AR(p) : Auto Regression of order p

Value at time T, linearly depends on previous terms, upto order p

$$X_t = \sum_{i=1}^{p} \psi_i * X_{t-i} + \epsilon_t$$

MA : Moving Average of order q

Value at time T is random error term + previous random error terms upto order q

$$X_t = \mu + \epsilon_t + \sum_{1=1}^{q} \theta_i * \epsilon_{t-i}$$

Invertibility of AR & MA models

An AR model can be written as an MA model and vice -versa

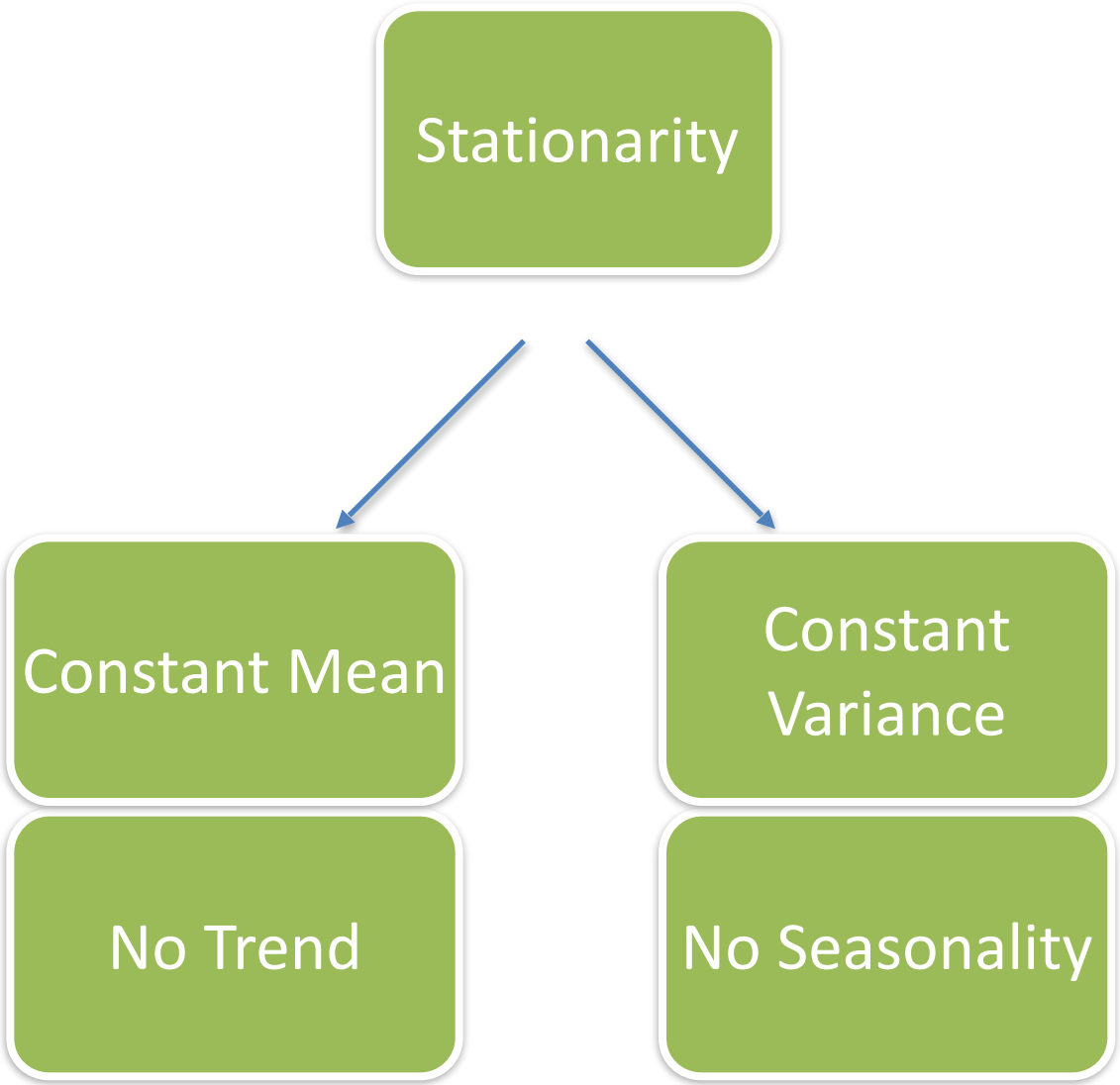
There are some cases where invertibility does not hold

ARMA : Auto Regressive & Moving Average

Model is a combination of AR and MA processes

$$X_t = c + \epsilon_t + \sum_{i=1}^{p} \psi_i * X_{t-i} + \sum_{i=1}^{q} \theta_i * \epsilon_{t-i}$$

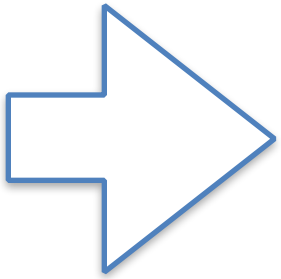
Requirement of ARMA {there is no I here. yet}



Achieving Stationarity: ARIMA (p,d,q)

Differencing

d



Order of differencing

ARMA model are built on differenced stationary data