**Forecasting – A short note**

We will learn three exponential smoothing techniques in the session – Simple Exponential Smoothing technique, Holt’s Trend Corrected Exponential Smoothing technique and the Multiplicative Holt Winter’s Exponential Smoothing technique. Exponential smoothing techniques give more weightage to more recent data than to older observations. This is done through smoothing constants.

**Simple Exponential Smoothing (SES)**

SES assumes that the time series data is made up of two components, a level and some error around that level.

Demand at level t = level + error around the level at time t

How do we calculate the level?

Level0 = average of the first year’s demand

Level1 = Level0 + (a constant)\*(Demand1 – Level0)

Level2 = Level1 + (a constant)\*(Demand2 – Level1)

Levelt = Levelt-1 + (a constant)\*(Demandt – Levelt-1)

If you have 36 months of data, the forecast in time period 37 would be Level36, and the forecast for time period 40 would be the same, Level36.

**Holt’s Trend Corrected Exponential Smoothing**

This method extends the simple exponential smoothing technique to create forecast from data that has a linear trend.

Demand at level t = level + t\*trend + error around the level at time t

If you have 36 months of data, the forecast in time period 37 would be Level36 + 1 month of the trend, and the forecast for time period 40 would be, Level36.+ 4 months of the trend.

We need an initial value of the level and the trend:

One common way is to plot half the data that is given. The slope of the line is trend0, and the intercept is level0.

Level1 = Level0 + Trend0 + alpha\* (Demand1 – (Level0 + Trend0))

So,

Level current period = Level previous period + Trend previous period + alpha\* (Demand current period – (Level previous period + Trend previous period))

Trend1  = Trend0 + gamma \* alpha \* (Demand1 – (Level0 + Trend0))

So,

Trend current period  = Trend previous period + gamma \* alpha \* (Demand current period – (Level previous period + Trend previous period))

**Holt Winter’s Exponential Smoothing**

It is the logical extension of Holt’s Trend Corrected Smoothing. It accounts for a level, a trend, and the need to adjust the demand up or down on a regular basis due to seasonal fluctuations.

Demand at time t = (level + t\*trend) \* seasonal adjustment for time t \* irregularity adjustments we can’t account for

So, as above, if we have 36 months of data,

Forecast for month 39 = (level36 + 3 \* trend36) \* seasonality27

Level1 = Level0 + Trend0 + alpha \* (Demand1 - (Level0+ Trend0) \* Seasonality-11)/Seasonality-11

Trend1  = Trend0  + gamma \* alpha \* (Demand1 - (Level0+ Trend0) \* Seasonality-11)/Seasonality-11

Seasonality1 = Seasonality0 + delta \* (1- alpha) \* (Demand1 - (Level0+ Trend0) \* Seasonality-11)/( Level0 + Trend0)