Calculating Initial Values for Level and Trend in Double Exponential Smoothing

The command Stat>Time Series>Double Exponential Smoothing can store columns of estimates for Level and Trend. Minitab uses one of the following methods to calculate the values in the first row of these columns, depending on the options you specify in the dialog box.

If you choose the option Optimal ARIMA under Weights to use in Smoothing, then Minitab uses the following method to calculate the first values of level and trend. You can perform these steps by hand.

1. First, Minitab calculates the optimal weight values using ARIMA: choose Stat>Time Series>ARIMA.
2. Uncheck Include constant term in model. In Autoregressive, enter 0. In Difference, enter 2. In Moving Average, enter 2.
3. Click Storage, check Residuals, then click OK twice.
4. Minitab uses the MA values in the ARIMA output to calculate the optimal weights as follows:
   \[ w_1 = 1 + MA_2 \]
   \[ w_2 = \frac{2 - w_1 - MA_1}{w_1} \]
5. Then, Minitab calculates back to the initial observation, using data from later observations:
   \[ p_2 = 2x_3 - x_4 - (MA_1 * e_3) - (MA_2 * e_4) \]
   \[ e_2 = x_2 - p_2 \]
   \[ p_1 = 2x_2 - x_3 - (MA_1 * e_2) - (MA_2 * e_3) \]
   \[ e_1 = x_1 - p_1 \]

where:

- \( p_i \) = the predicted value of the \( i^{th} \) smoothed observation
- \( x_i \) = the value of the \( i^{th} \) observation in your time series
- \( e_i \) = the value of the \( i^{th} \) residual, stored from the ARIMA command above

6. Minitab calculates the initial value for level (\( L_1 \)) according to this formula:
   \[ L_1 = p_1 + w_1 * (e_1) \]

7. Minitab calculates the initial value for trend (\( T_1 \)) according to this formula:
   \[ T_1 = p_2 - L_1 \]
Calculating Initial Values for Level and Trend in Double Exponential Smoothing

If you specify your own weights for level and trend under Weights to use in Smoothing in the Double Exponential Smoothing dialog box, then Minitab uses the following method to calculate the first values for level and trend. You can perform these steps by hand.

1. Create a column of Time Indices equal to the length of your column of time series data. A column of integers from 1 to n is sufficient.
3. Click Storage and check Coefficients. Click OK twice.
4. The initial level value equals:
   
   \[ L_1 = w_L \times x_1 + (1 - w_L) (\beta_0 + \beta_1) \]

5. The initial trend value equals:
   
   \[ T_1 = w_T \times (L_1 - \beta_0) + (1 - w_T) \times \beta_1 \]

where:

- \( L_1 \) = initial level value
- \( x_1 \) = the value of the first observation in your time series
- \( T_1 \) = initial trend value
- \( w_L \) = the weight value you specified for level
- \( w_T \) = the weight value you specified for trend
- \( \beta_0 \) = the coefficient of the constant term in the regression model
- \( \beta_1 \) = the coefficient for the predictor term in the regression model