

- Using Excel, we compute the additive Holt winters Method to the Bike sales data to forecast the future sales of bikes. First, we compute  $l_0$ ,  $b_0$ ,  $sn_{-3}$ ,  $sn_{-2}$ ,  $sn_{-1}$ ,  $sn_0$ , using the first two years of the data. These values are computed to be,

$$\begin{aligned}l_0 &= 21.25 \\b_0 &= 0.98088 \\sn_{-3} &= -14.6162 \\sn_{-2} &= 6.15294 \\sn_{-1} &= 18.17206 \\sn_0 &= -11.308823\end{aligned}$$

- We now let  $\alpha = 0.2$ ,  $\beta = 0.2$ ,  $\gamma = 0.1$ . This results in the values of,

$$\begin{aligned}SSE &= 769.0924608 \\MSE &= 59.16095852 \\s &= 7.691616\end{aligned}$$

- We then optimize the values of  $\alpha$ ,  $\beta$ ,  $\gamma$  to find the minimum value of  $SSE$  This results in,

$$\begin{aligned}\alpha &= 0 \\\beta &= 0.358 \\\gamma &= 1\end{aligned}$$

These values produce a  $SSE = 191.5530$

- Finally, we compute the forecast and interval for the sales in the fourth quarter of year 5. First,

$$y_{20} = l_{16} + 4b_{16} + sn_{13} = 28.923529$$

Our interval is then,

$$\left[ y_{20} \pm z^* s \sqrt{1 + \sum_{j=1}^3 \alpha^2 (1 + j\gamma)^2} \right] = [21.39987, 36.4472]$$