Chapter 3: Case 3 – Consumer Credit Counseling

1. Develop a naïve model to forecast the number of new clients seen by CCC for the rest of 1993.

The simple naïve forecasting method is not an appropriate forecasting technique as it uses the value of the last period to forecast the next period. As we can see from the decomposition of the data (Figure 1), there is clearly a trend and seasonal component present in the time series.

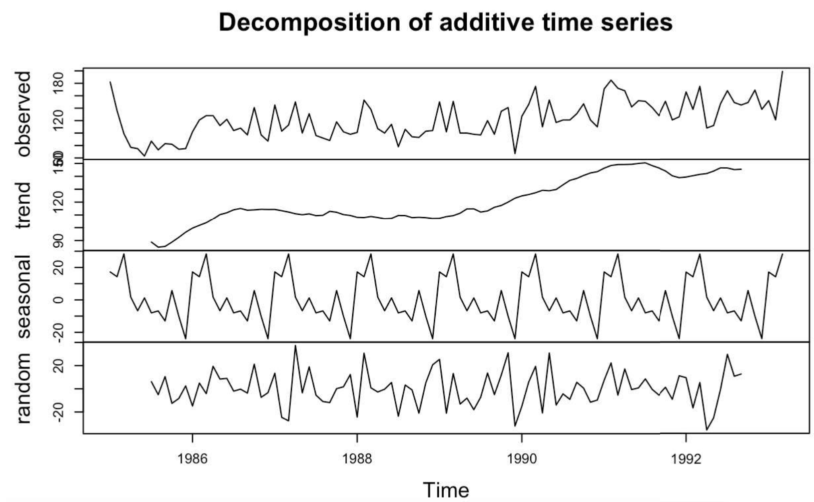

Figure 1: Decomposition of the data, elaborated with R.

Hence, the best naïve model is a model that accounts for these components.

$$\hat{Y}_{t+1} = Y_{t-11} + \frac{Y_t - Y_{t-12}}{12}$$

Where:

$\hat{Y}_{t+1}$ = the forecast made at time *t* for time *t+1*

Y_t= the actual observation at time *t*

The forecast until March 1993 and error measures can be found in the attachment.

2. Develop a moving average model to forecast the number of new clients seen by CCC for the rest of 1993.

As the moving average forecasting method does not handle trend or seasonality very well [HW], it is not an appropriate technique to forecast the new clients of the rest of 1993.

For training purposes, we still applied it to the data, which can be found in the attachment. We used the double moving average method with a k of 3 months.

3. Develop an exponential smoothing procedure to forecast the number of new clients seen by CCC for the rest of 1993.

From Figure 1 we can clearly see that there is a trend and seasonal component present. Thus, the simple exponential smoothing procedure is not an accurate technique to apply. Therefore, we decided to use the Winters' method as our forecasting method.

The formula to forecast for example January 1993 (Period 97) is:

$$L_{96} = \alpha \frac{Y_{96}}{S_{96-12}} + (1-\alpha)(L_{96-1} + T_{96-1})$$

$$T_{96} = \beta(L_{96} - L_{96-1}) + (1-\beta)T_{96-1}$$

$$S_{96} = \gamma \frac{Y_{96}}{L_{96}} + (1-\gamma)S_{96-12}$$

$$\hat{Y}_{96+1} = (L_{96} + 1 * T_{96})S_{96-12+1}$$

We let R optimize the values for α, β and γ, which gave us the values of 0.234423, 0.03869 and 0.23525 respectively.

The forecasting can be found in the attachment.

4. Evaluate these forecasting methods using the forecast error summary measures.

Error Measure	**Naïve Forecasting**	**Moving Average**	**Winters' method**
MAD	23.3982	24.8688	17.5542
MSE	841.21	1038	463.6374
RMSE	29	32.2182	21.5322
MAPE	19%	21%	15%
MPE	5%	-1%	-4%

Table 1: Error measures of the different forecasting methods. See attachment for the computation of the errors.

Looking at the error measures, we can clearly see that the Winters' method gives us the best forecasting method. Comparing the MSE gives us a good vision of the superiority of this technique compared to the other ones in this case.

5. Choose the best model and forecast new clients for the rest of 1993.
From 4. we know that the best available model is the Winters' model. Thus we use this technique to forecast the new clients for the rest of 1993, which can be found in the following table.

	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1993	152	148	158	154	149	145	159	149	133

Table 2: Forecast of the numbers of clients for 9 periods (h=9). The values are approximated to the closest integer.

Further Figure 2 gives us a graphical interpretation of the forecast:

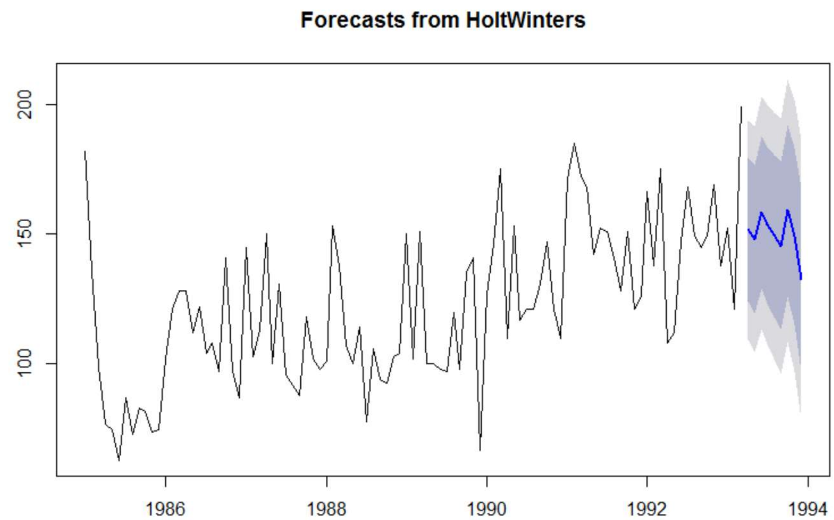

Figure 2: Forecasts using the Winter's method

The blue line in Figure 2 indicates the forecasted values, while the area around it displays the confidence interval.

6. Determine the adequacy of the forecasting model you have chosen.

We determine the adequacy of our forecasting model by computing the autocorrelation function of the residuals, which can be found in Figure 3.

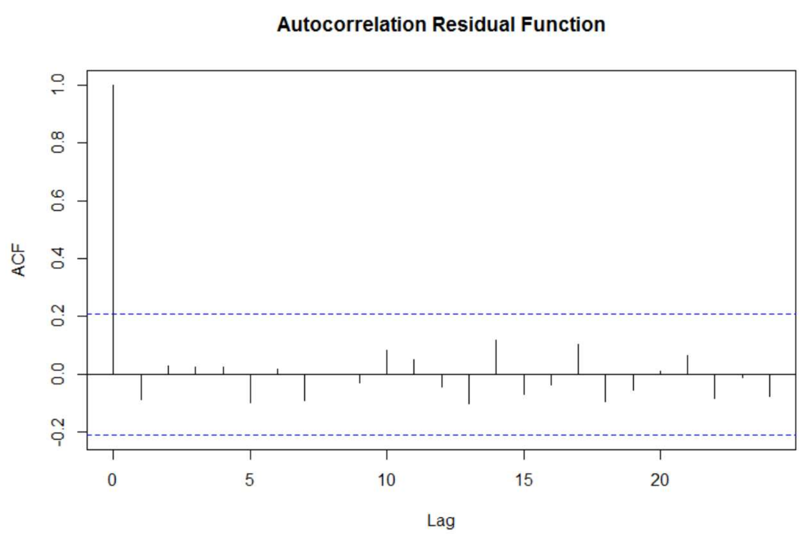

Figure 3: Autocorrelation Function Residuals computed with R

This Figure shows us, that none of the residuals is significantly different from zero. Thus, we conclude that our chosen forecasting technique is appropriate because our residuals have approximate mean of zero and constant variance, which is the distribution of the residuals [HW] when the forecasting model adequately predicted the trend and seasonality of the series. This means that the model succeeded in predicting the seasonal and trend component.