ETW3420

Principles of Forecasting and Applications

Topic 4 Exercises

Question 1

Show that a 3×5 MA is equivalent to a 7-term weighted moving average with weights of 0.067, 0.133, 0.200, 0.200, 0.200, 0.133, and 0.067.

Hint:

5-term moving average:

$$z_j = \frac{1}{5}(y_{j-2} + y_{j-1} + y_j + y_{j+1} + y_{j+2}).$$

3-term moving average:

$$u_t = \frac{1}{3}(z_{t-1} + z_t + z_{t+1}).$$

Question 2

The `plastics` data set consists of the monthly sales (in thousands) of product A for a plastics manufacturer for five years.

(a) Plot the time series of sales of product A. Can you identify seasonal fluctuations and/or a trend-cycle?

(b) Use a classical multiplicative decomposition to calculate the trend-cycle and seasonal indices.

(c) Do the results support the graphical interpretation from part a? What can we learn from this?

(d) Calculate the trend-cycle component by using an appropriate centred moving average and confirm if the values obtained are identical with those obtained in Part(b)

```
ma(plastics, order = ___ , centre = ____)
```

(e) Compute and plot the seasonally adjusted data.

(f) Superimpose the time series plot with the seasonally adjusted data.

Question 3

We will use the `a10` data (Total monthly scripts for pharmaceutical products falling under ATC code A10, as recorded by the Australian Health Insurance Commission, July 1991 - June 2008) for this exercise.

(a) Plot the data and determine if a Box-Cox transformation is necessary.

(b) Use an STL decomposition to calculate the trend-cycle and seasonal indices. (Experiment with having fixed or changing seasonality.)

```
#STL with fixed seasonality
fit <- stl(y, s.window='periodic')
autoplot(fit)
```

```
#STL with changing seasonality
fit2 <- stl(y, s.window = 9)
autoplot(fit2)
```

The seasonality looks fairly stable, so we'll use a periodic `s.window`.

(c) Compute and plot the seasonally adjusted data.

(d) Use a drift method to produce forecasts of the seasonally adjusted data.

(e) Use `stlf` to reseasonalize the results, giving forecasts for the original data.

- Note that the first argument of the `stlf()` function is the variable in its level form. The subsequent `lambda` argument will take care of the Box-Cox transformation, and the reverse transformation.

- This is what the `stlf()` function does:
  - It seasonally adjusts the data from an STL decomposition.
  - Using the forecasting method specified in the `method` argument, the seasonally adjusted data is forecasted.
  - The seasonal component from the last year of data is then added back into the forecasts of the seasonally adjusted data.
  - The result returned is hence the reseasonalized forecasts.

(e) Do the residuals look uncorrelated?

```
## Warning in checkresiduals(fc): The fitted degrees of freedom is based on
## the model used for the seasonally adjusted data.
```

(f) Compare forecasts from `stlf` with those from `snaive`, using a test set commencing from July 2006. Which is better?

```r
#Create train and test sets
train <- window(a10, end = c(2006, 6))
test <- window(a10, start = c(2006, 7))
```

```r
#(continue with the code)
```

Question 4 (Self-Practice)

Use `stlf` to produce forecasts of the `writing` and `fancy` series with either `method="naive"` or `method="rwdrift"`, whichever is most appropriate. Use the `lambda` argument if you think a Box-Cox transformation is required.