Time-Series Forecasting

ECON20222 - Lecture 10

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Aim for today

- Identify the presence of seasonal features in a time-series
- Use AR models to produce single step ahead forecasts
- Use AR models to produce multiple step ahead forecasts
- Evaluate and compare different forecasts

Forecasting basics

Let's say we have a time series y_t, for $t = 1, ..., T$ where T is the last available observation.

The aim is to use the observations available to obtain 1 step - or more generally h step ahead forecasts.

$$E(y_{T+1}|y_T, y_{T-1}, y_{T-2}, ...) = E(y_{T+1}|I_T) = \hat{y}_{T+1|T}$$

$$E(y_{T+h}|y_T, y_{T-1}, y_{T-2}, ...) = E(y_{T+h}|I_T) = \hat{y}_{T+h|T}$$

We call I_t the information set.

1. We use the data in the information set to estimate a model representing the process
2. We then use this estimated model to obtain a forecast

Forecasting basics

- We may want to use information from other time-series, x_t, z_t etc.
- This opens up more complex models and the additional information may add quality to the forecast.
- But if you forecast multiple steps ahead then we need forecasts for these to obtain forecasts for y.

Forecasting basics - Uncertainty

When forecasting we know from the outset that our forecast is not going to hit the actual outcome and hence we should expect the forecast error

$$\epsilon_{T+1|T} = y_{T+1} - \hat{y}_{T+1|T}$$

to be unequal to 0. Note that y_{T+1} is the actual observation which we don't have at time T.

Forecasting basics - Uncertainty

We should expect forecasts to be imperfect for the following reasons:

- Even the best model will not capture all the random variation
- Which variables are relevant for forecasting y?
- What is the right model?
- When estimating a model we will have uncertainty about the parameters.

All of these are actually quite harmless when carefully modelled, **but** significant forecast errors will arise of there are changes in the process which effect the process such that:

- the overall (unconditional mean) of the process changes
- the trend of a series changes

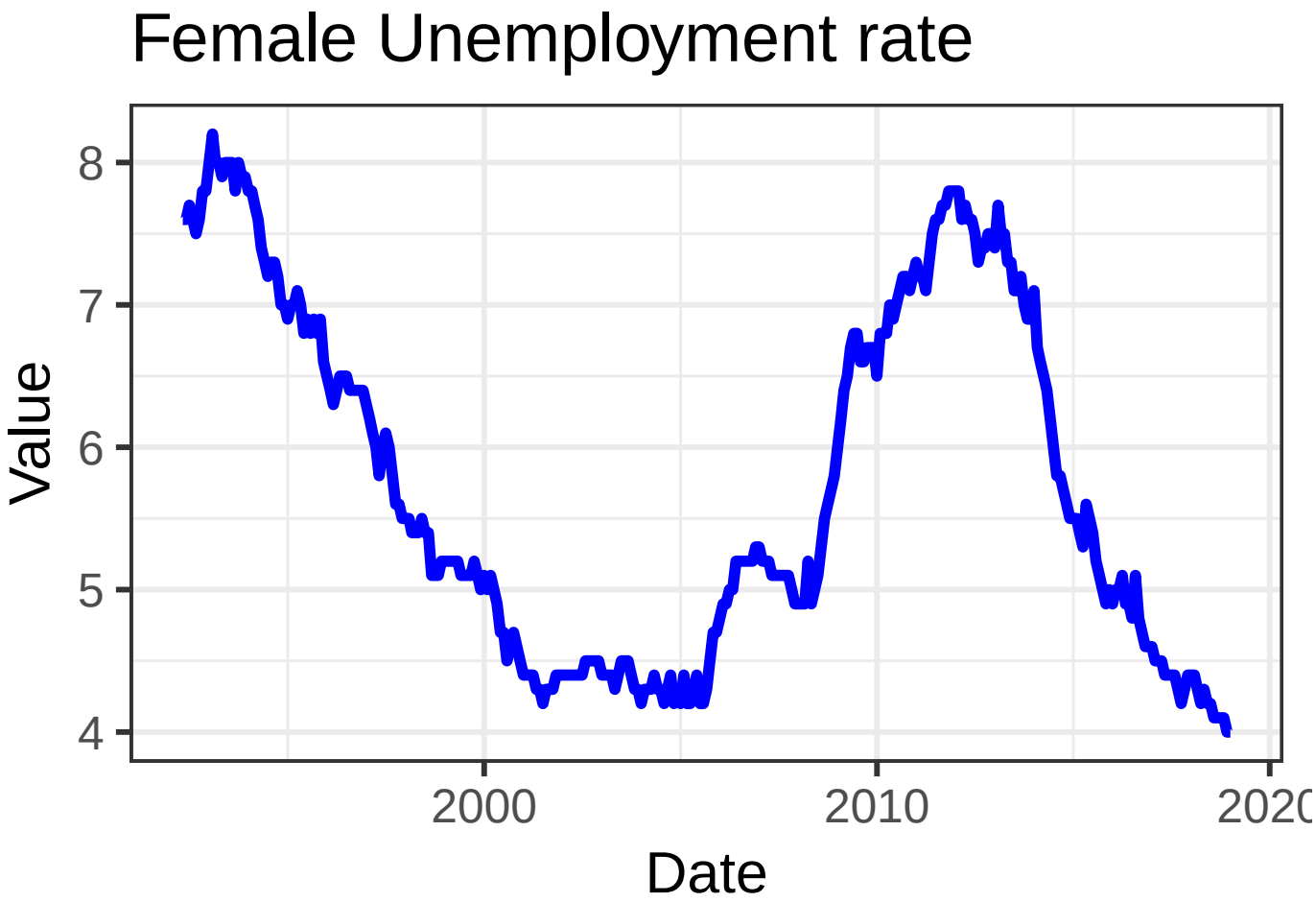
Our working example - female unemployment rate

```
# Download: Female unemployment rate (YCPL in database LMS)
ur_female <- pdfetch_ONS("YCPL","LMS")
names(ur_female) <- "Unemp Rate (female)"

# keep all the data including 2018-Dec
# this was the last observation available at the time this was
# remove this line if you want to use updated data
ur_female <- ur_female["/2018-12"]

ur_female_l <- data.frame(index(ur_female),
                  stack(as.data.frame(coredata(ur_female))))
names(ur_female_l)[1] <- "Date"
names(ur_female_l)[2] <- "Value"
names(ur_female_l)[3] <- "id"
```

Our working example - female unemployment rate



Summary

We learned that

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