FORECASTING USING R

Welcome to Forecasting Using R

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Author, forecast

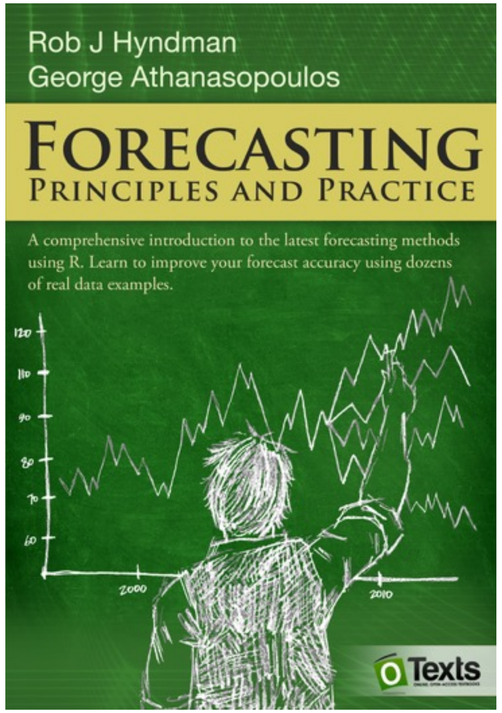
What you will learn

- Exploring and visualizing time series
- Simple benchmark methods for forecasting
- Exponential smoothing and ARIMA models
- Advanced forecasting methods
- Measuring forecast accuracy
- Choosing the best method

Course textbook

Hyndman, R. J. & Athanasopoulos, G. (2017)

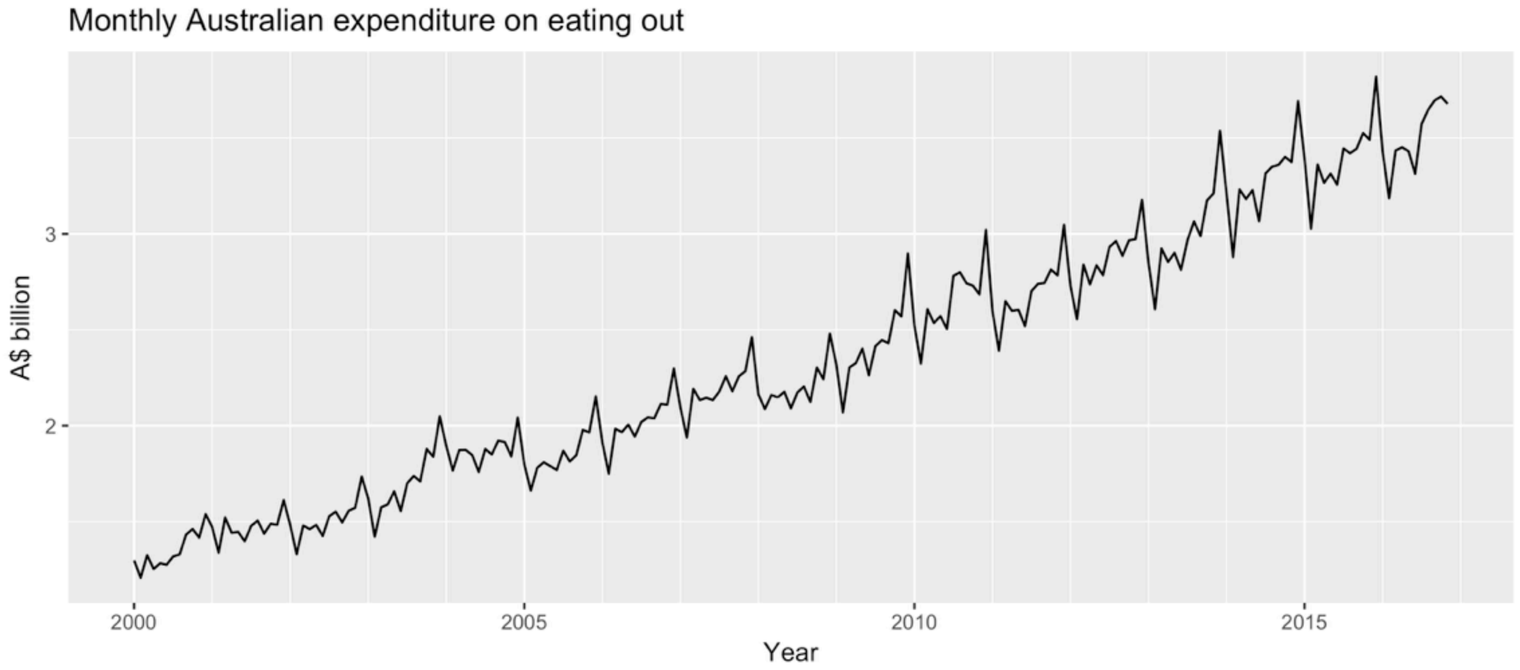
***Forecasting: principles and practice*, 2nd edition**



- Free and online at OTexts.org/fpp2/
- Data sets in associated R package `fpp2`
- R code for all examples

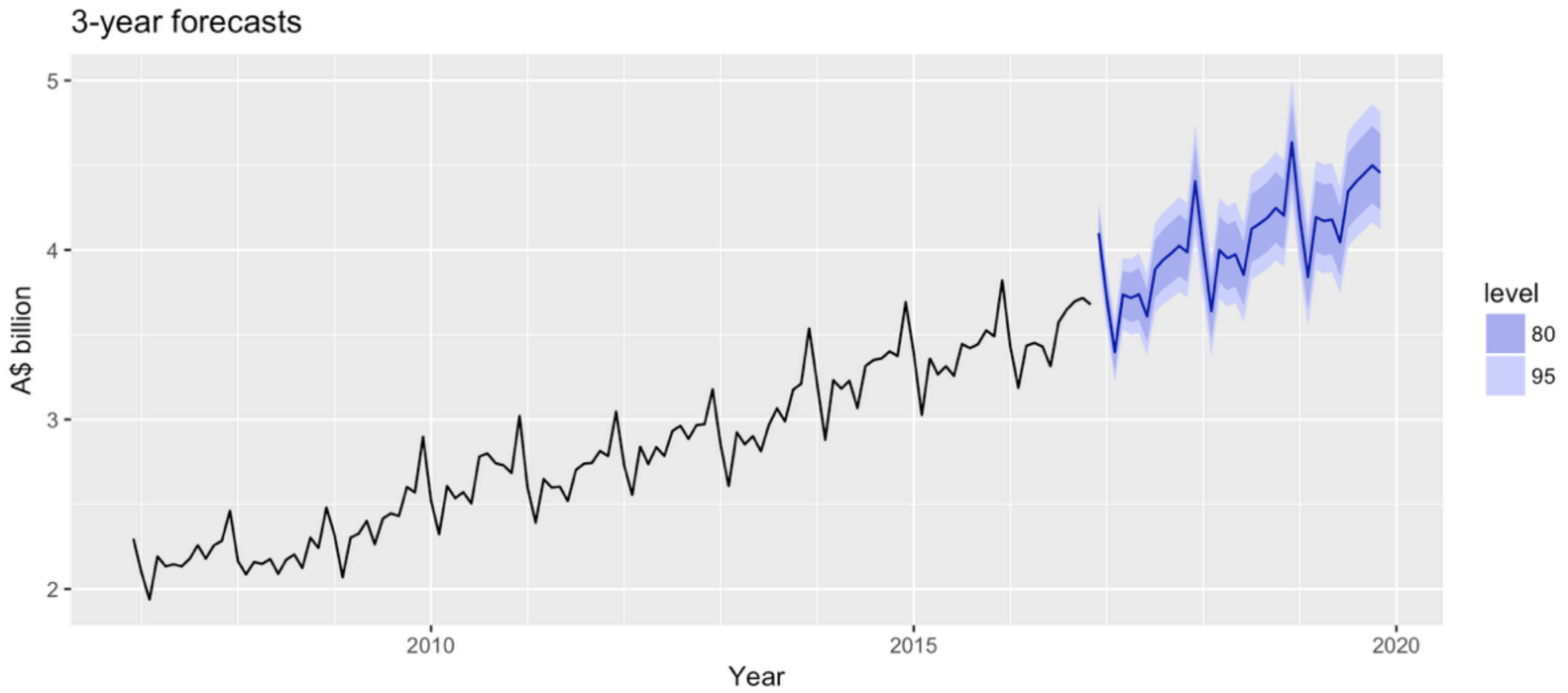
Time series data

- Series of data observed over time
- Eg.: Daily IBM stock prices, monthly rainfall in London,...



Forecasting is estimating how the sequence of observations will continue into the future.

Forecasts of monthly Australian expenditure on eating out



- What forecasting methods are available that take account of trend, seasonality and other features of the data?
- How to measure the accuracy of your forecasts?
- How to choose a good forecasting model?

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Let’s practice!

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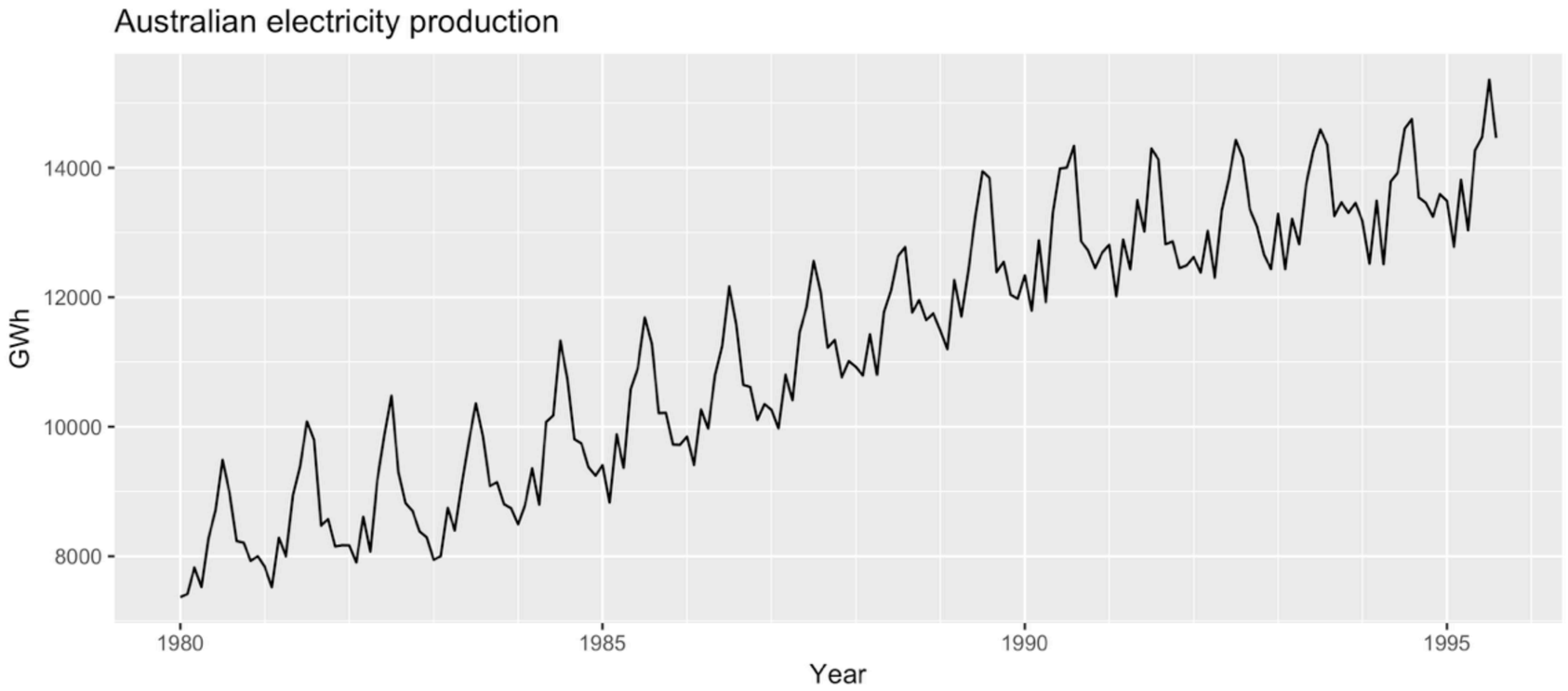
Trends, seasonality, and cyclicity

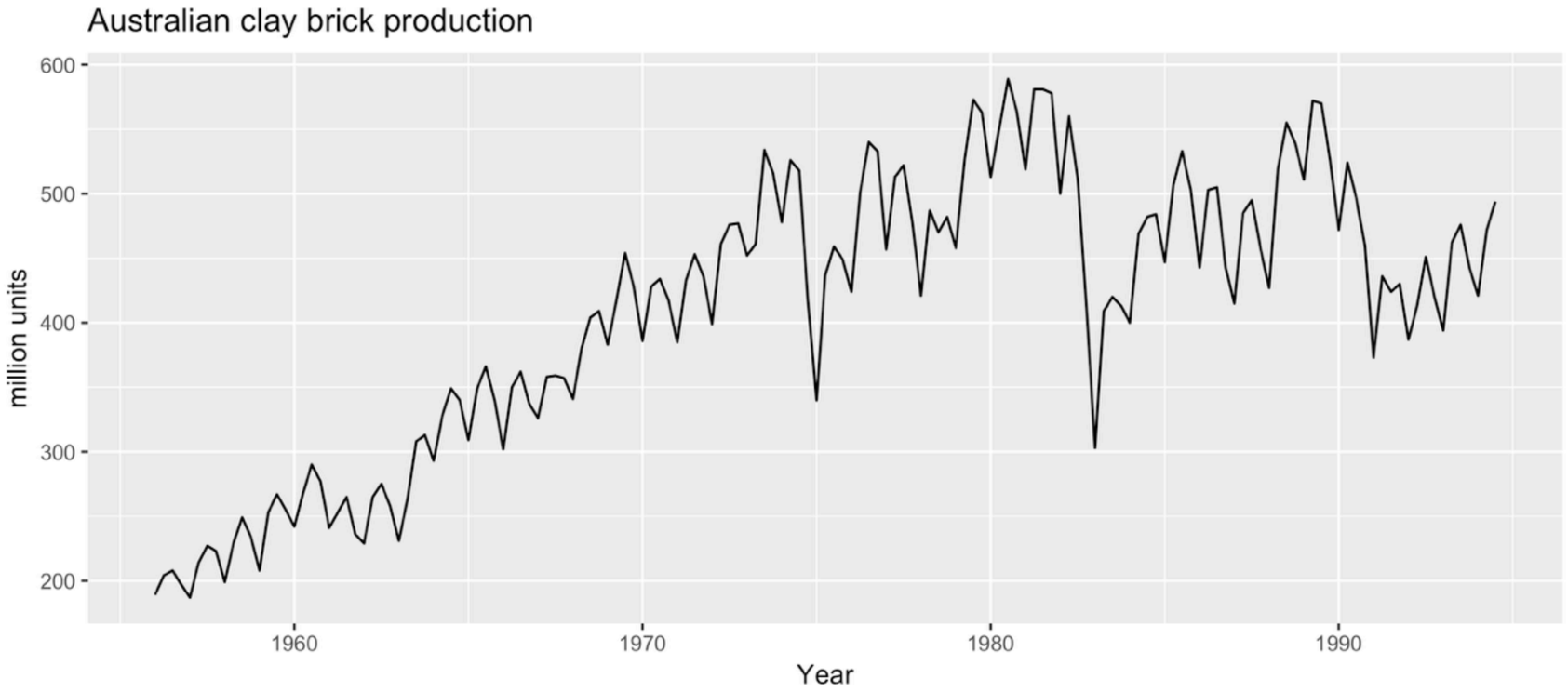
Time series patterns

Pattern	Description
Trend	A pattern exists involving a long-term increase OR decrease in the data
Seasonal	A periodic pattern exists due to the calendar (e.g. the quarter, month, or day of the week)
Cyclic	A pattern exists where the data exhibits rises and falls that are *not of fixed period* (duration usually of at least 2 years)

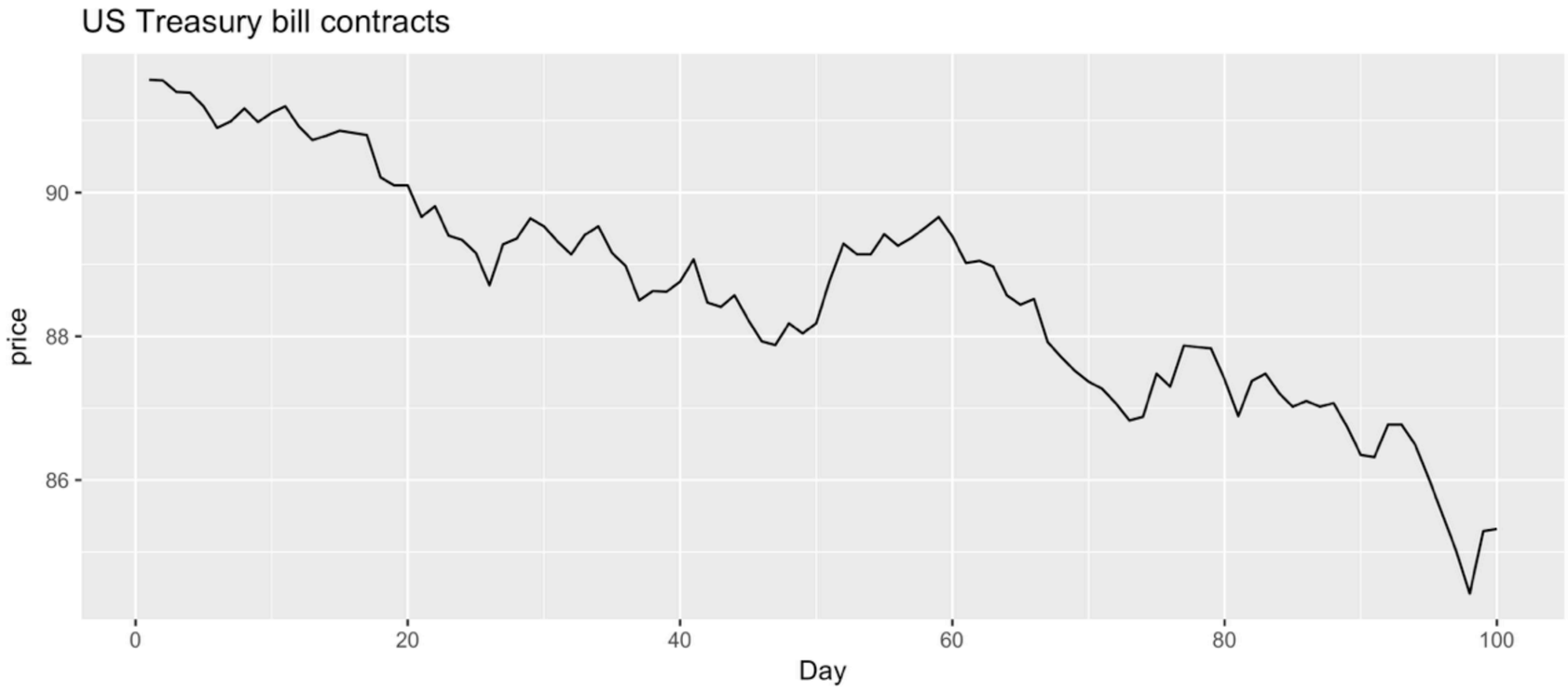
Examples of time series patterns



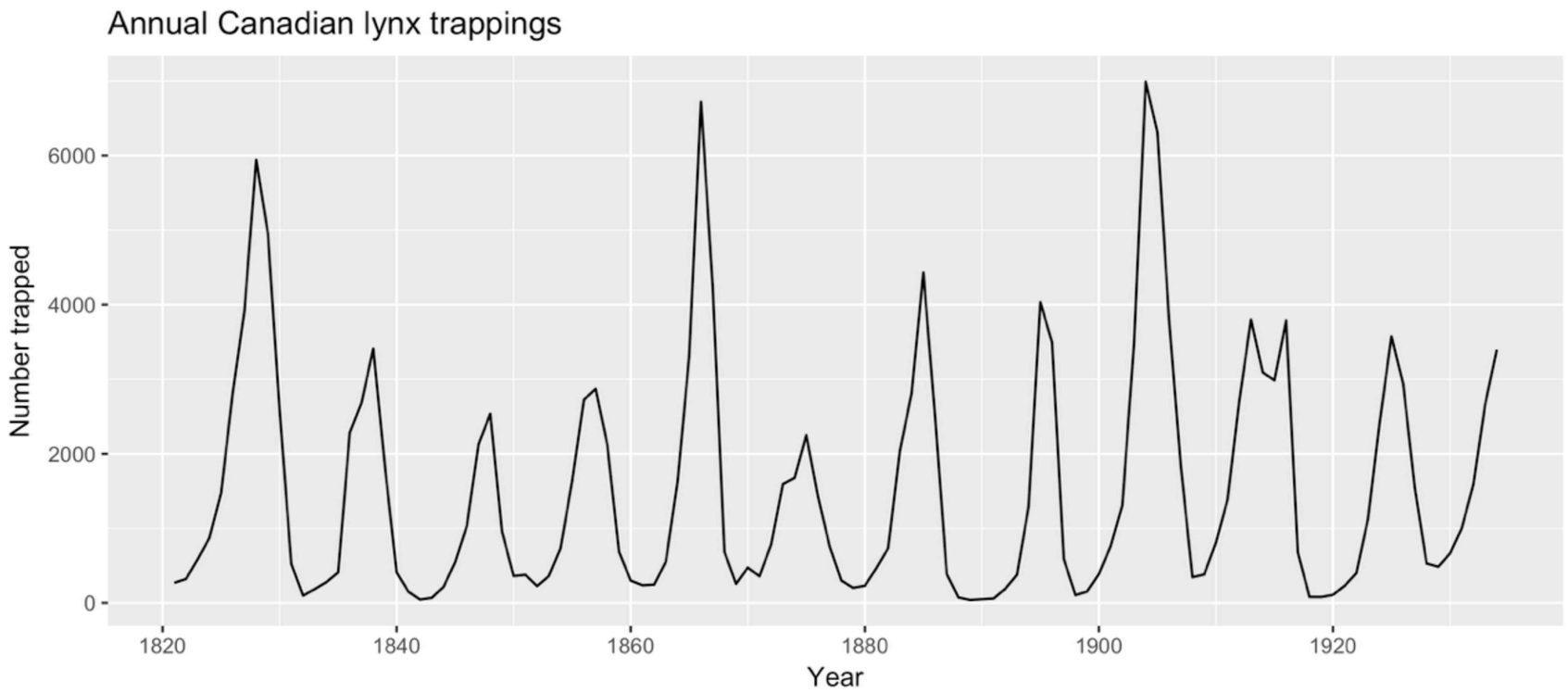
Examples of time series patterns



Examples of time series patterns



Examples of time series patterns



Seasonal or cyclic?

Differences between seasonal and cyclic patterns:

- Seasonal pattern constant length vs. cyclic pattern variable length
- Average length of cycle longer than length of seasonal pattern
- Magnitude of cycle more variable than magnitude of seasonal pattern

The timing of peaks and troughs is predictable with seasonal data, but unpredictable in the long term with cyclic data.

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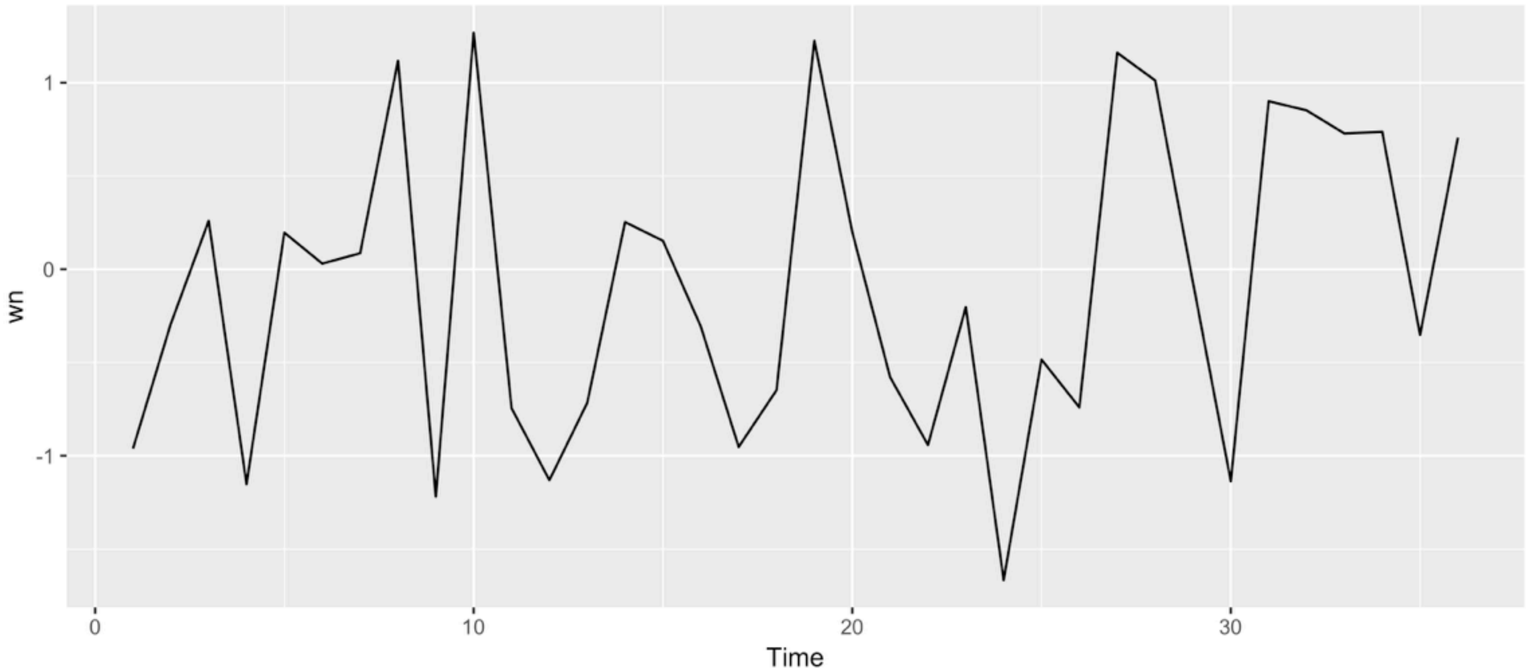
White noise

White noise

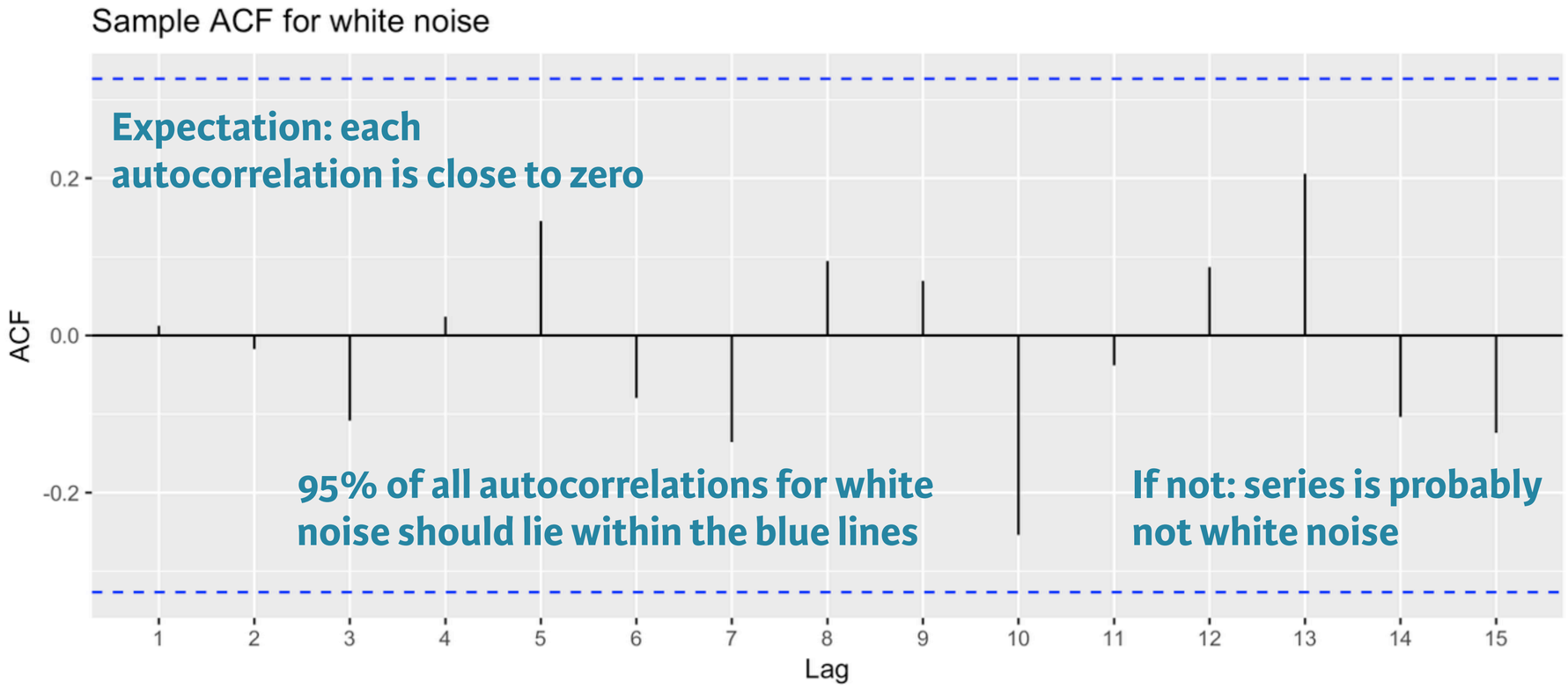
```
> set.seed(3)            # Reproducibility
> wn <- ts(rnorm(36))    # White noise
> autoplot(wn)           # Plot!
```



"White noise" is just a time series of iid data

White noise ACF

```
> ggAcf(wn) +
    ggtitle("Sample ACF for white noise")
```

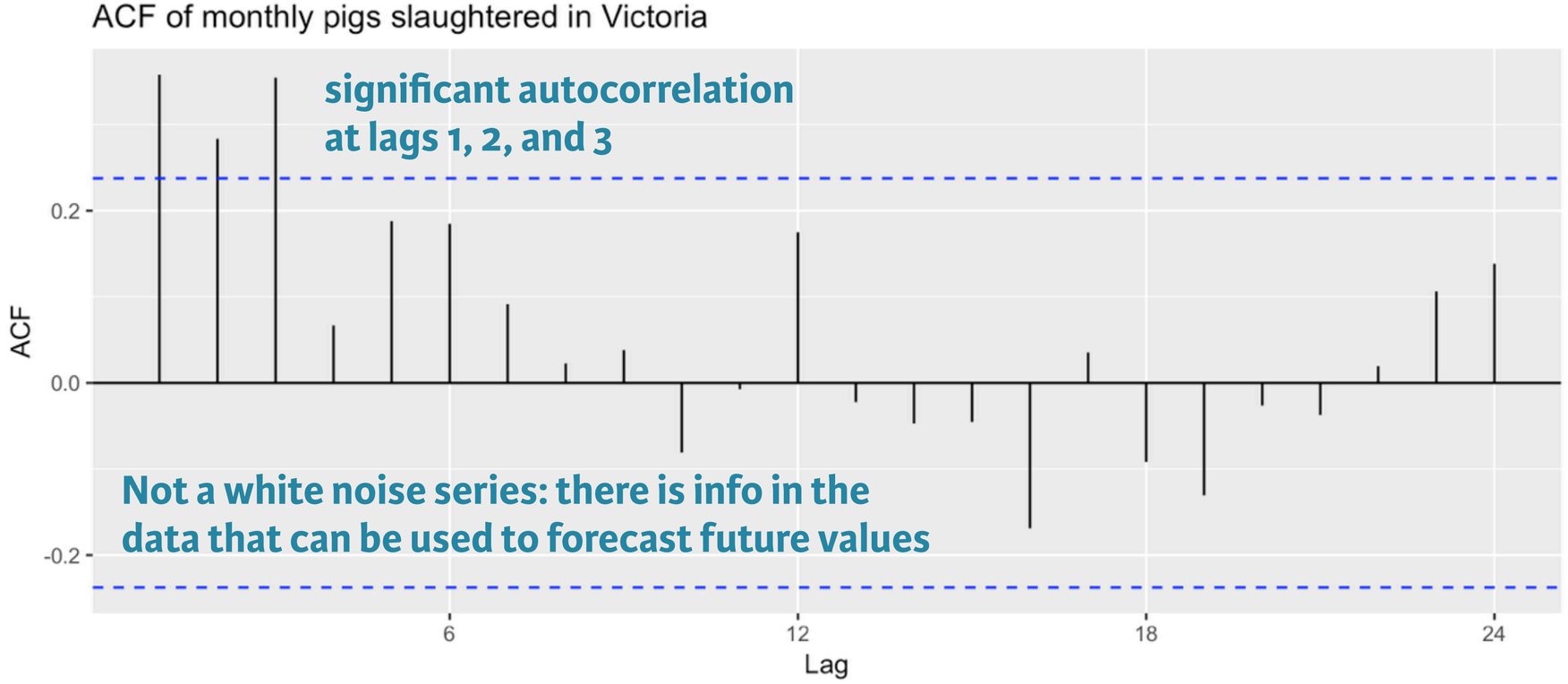


Example: Pigs slaughtered

```
> autoplot(pigs/1000) +
>  xlab("Year") +
>  ylab("thousands") +
>  ggtitle("Monthly number of pigs
          slaughtered in Victoria")
```

Example: Pigs slaughtered

```
> ggAcf(pigs) +
> ggtitle("ACF of monthly pigs slaughtered
          in Victoria")
```



Ljung-Box test

The Ljung-Box test considers the first *h* autocorrelation values **together**.

A significant test (small p-value) indicates the data are probably not white noise.

```
> Box.test(pigs, lag = 24, fitdf = 0, type = "Lj")

Box-Ljung test

data:  pigs
X-squared = 634.15, df = 24, p-value < 2.2e-16
```

White noise summary

- White noise is a time series that is purely random
- We can test for white noise by looking at an ACF plot or by doing a Ljung-Box test

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