MONASH University

MONASH BUSINESS SCHOOL

ETC3550/ETC5550 Applied forecasting

Week 3: Time series decomposition

Outline

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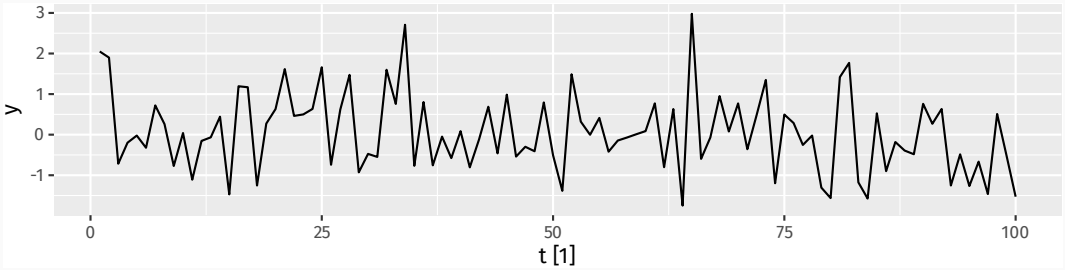
White noise

White noise data consists of purely random draws from the same distribution with mean zero and constant variance.

$$y_t = \varepsilon_t, \qquad \text{where } \varepsilon_t \overset{\text{iid}}{\sim} N(0, \sigma^2)$$

```
my_data <- tsibble(t = seq(100), y = rnorm(100), index = t)
my_data |> autoplot(y)
```



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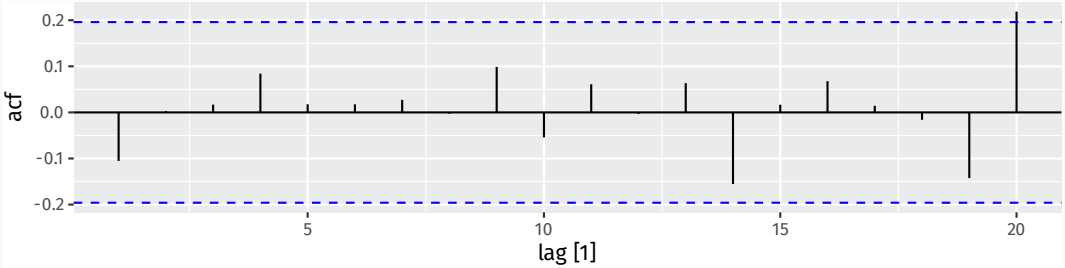
```
my_data |> ACF(y) |> autoplot()
```



Random walks

Random walks are a type of time series where the value at time t is equal to the previous value plus a random amount from a white noise process.

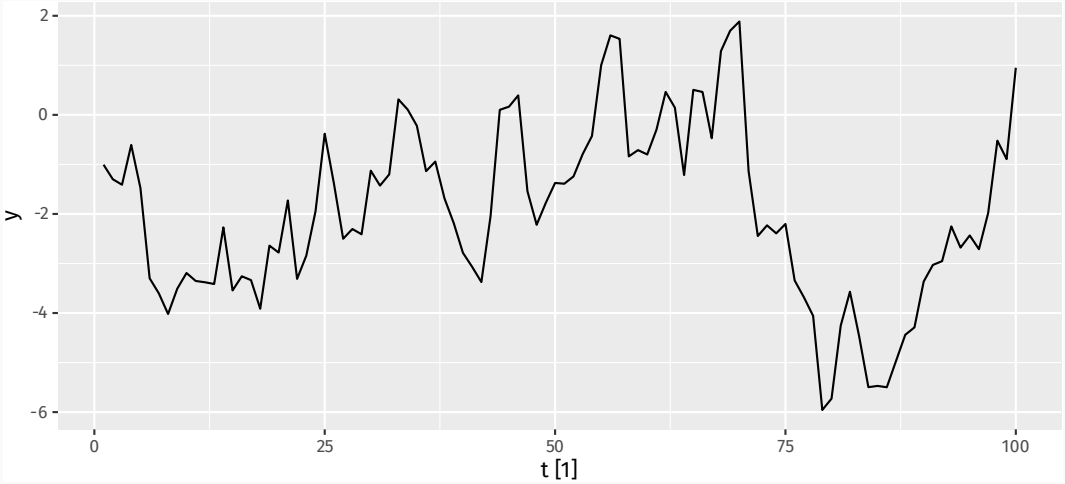
$$y_t = y_{t-1} + \varepsilon_t, \qquad \text{where } \varepsilon_t \overset{\text{iid}}{\sim} N(0, \sigma^2)$$

Equivalently, we can take the cumulative sum of a white noise process.

$$y_T = y_0 + \sum_{t=1}^{T} \varepsilon_t, \qquad \text{where } \varepsilon_t \overset{\text{iid}}{\sim} N(0, \sigma^2)$$

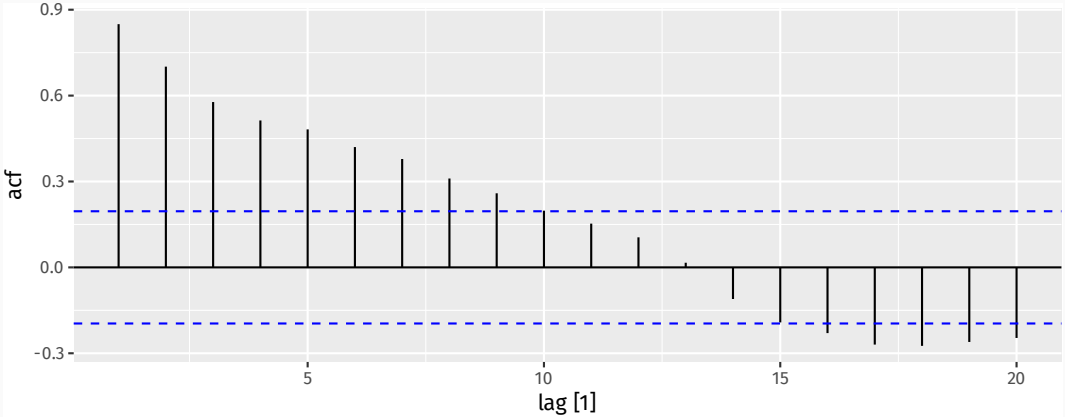
Random walks

```
my_data |> autoplot(y)
```



Random walks

```
my_data |> ACF(y) |> autoplot()
```



Outline

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The ABS stuff-up

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Treasurer Joe Hockey calls for answers over Australian Bureau of Statistics jobs data

By Michael Vincent and Simon Frazer

Updated 9 Oct 2014, 12:17pm

Federal Treasurer Joe Hockey says he wants answers to the problems the Australian Bureau of Statistics (ABS) has had with unemployment figures.

Mr Hockey, who is in the US to discuss Australia's G20 agenda, said last month's unemployment figures were "extraordinary".

The rate was 6.1 per cent after jumping to a 12-year high of 6.4 per cent the previous month.

The ABS stuff-up

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BREAKING NEWS Police arrest man in connection with stabbing death of 17-year-old Masa Vukotic in Mel

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ABS abandons seasonal adjustment for latest jobs data

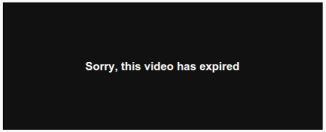
By business reporter Michael Janda

Updated 8 Oct 2014, 4:19pm

The Australian Bureau of Statistics is taking the rare step of abandoning seasonal adjustment for its latest employment data.

The ABS uses seasonal adjustment, based on historical experience, to account for the normal variation between hiring and firing patterns between different months.

However, after a winter where the seasonally adjusted unemployment rate swung wildly from 6.1 to 6.4 and back to 6.1 per cent, the bureau released a statement saying it will not adjust the original figure for September for seasonal factors.



VIDEO: Westpac chief economist Bill Evans discusses the ABS jobs data changes (ABC News)

RELATED STORY: Doubt the record breaking jobs figures? So does the ABS

RELATED STORY: Jobs increase record sees unemployment slashed

The ABS stuff-up

ABS jobs and unemployment figures – key questions answered by an expert

A professor of statistics at Monash University explains exactly what is seasonal adjustment, why it matters and what went wrong in the July and August figures

School leavers come on to the jobs market at the same time, causing a seasonal fluctuation. Photograph: Brian Snyder/Reuters

The Australian Bureau of Statistics has retracted its seasonally adjusted employment data for July and August, which recorded huge swings in the jobless rate. The ABS is also planning to review the methods it uses for seasonal

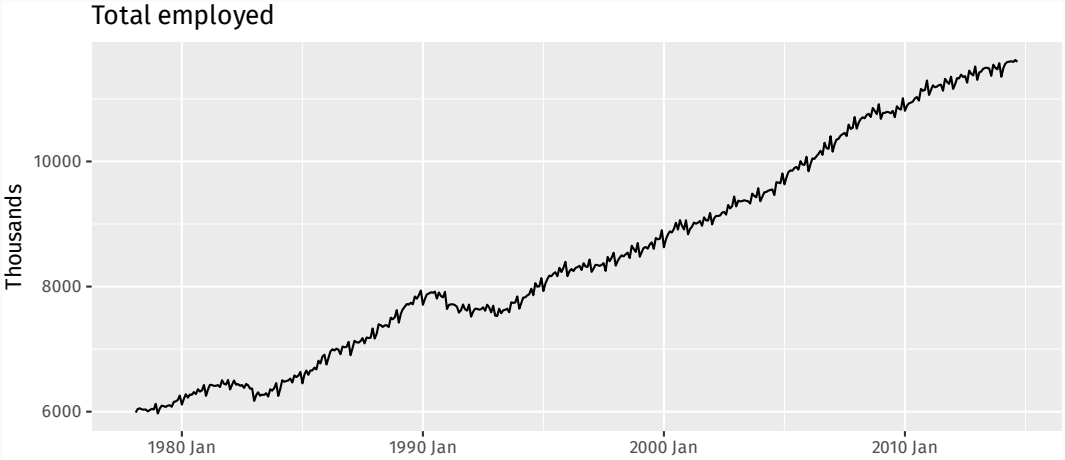
The ABS stuff-up

```
employed
```

```
# A tsibble: 440 x 4 [1M]
       Time Month  Year Employed
      <mth> <ord> <dbl>    <dbl>
 1 1978 Feb Feb    1978    5986.
 2 1978 Mar Mar    1978    6041.
 3 1978 Apr Apr    1978    6054.
 4 1978 May May    1978    6038.
 5 1978 Jun Jun    1978    6031.
 6 1978 Jul Jul    1978    6036.
 7 1978 Aug Aug    1978    6005.
 8 1978 Sep Sep    1978    6024.
 9 1978 Oct Oct    1978    6046.
10 1978 Nov Nov    1978    6034.
# i 430 more rows
```

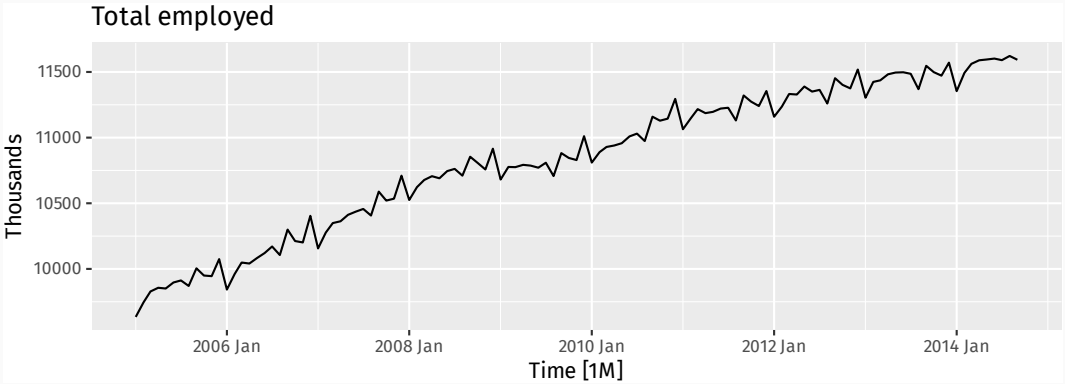
The ABS stuff-up

```
employed |>
  autoplot(Employed) +
  labs(title = "Total employed", y = "Thousands")
```



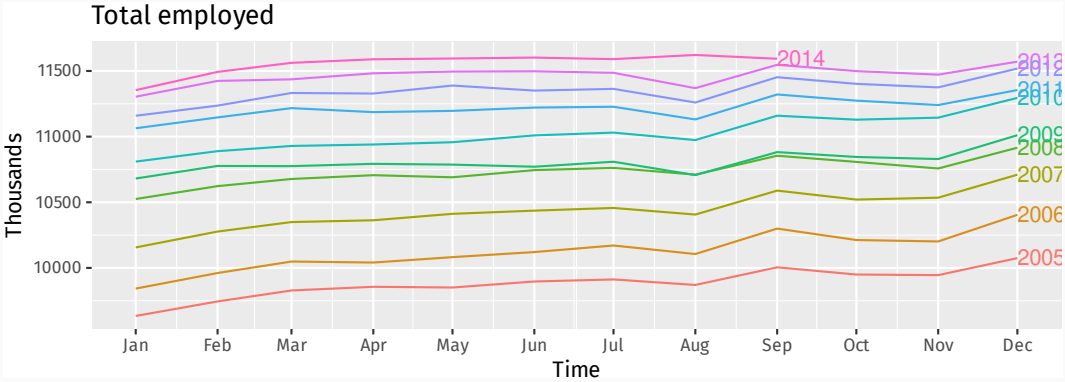
The ABS stuff-up

```
employed |>
  filter(Year >= 2005) |>
  autoplot(Employed) +
  labs(title = "Total employed", y = "Thousands")
```



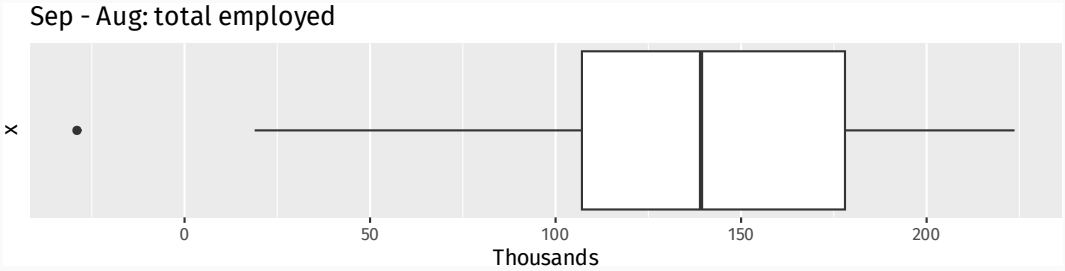
The ABS stuff-up

```
employed |>
  filter(Year >= 2005) |>
  gg_season(Employed, labels = "right") +
  labs(title = "Total employed", y = "Thousands")
```



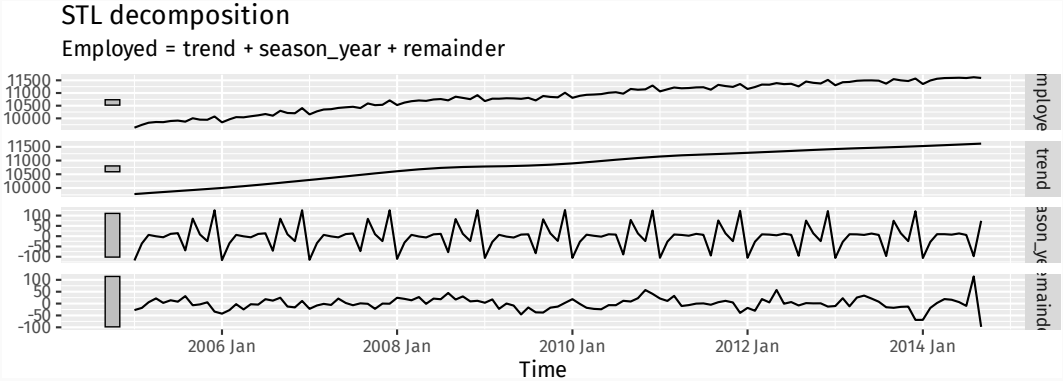
The ABS stuff-up

```
employed |>
  mutate(diff = difference(Employed)) |>
  filter(Month == "Sep") |>
  ggplot(aes(y = diff, x = 1)) +
  geom_boxplot() +
  coord_flip() +
  labs(title = "Sep - Aug: total employed", y = "Thousands") +
  scale_x_continuous(breaks = NULL, labels = NULL)
```



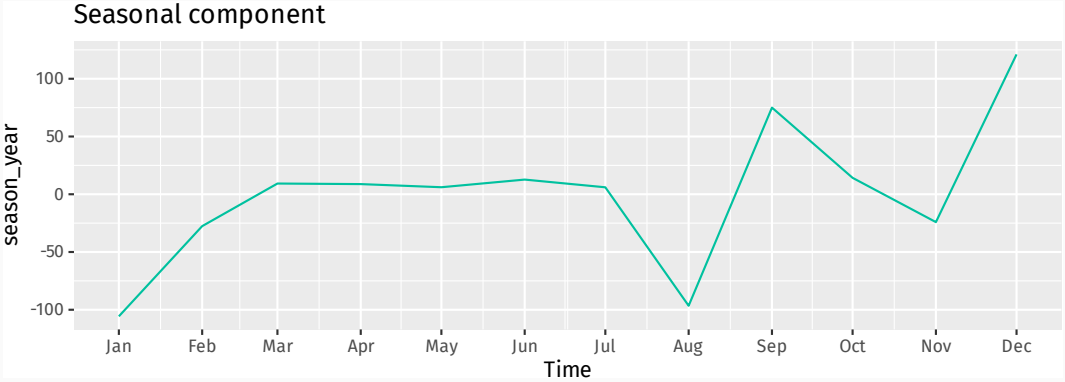
The ABS stuff-up

```
dcmp <- employed |>
  filter(Year >= 2005) |>
  model(stl = STL(Employed ~ season(window = 11), robust = TRUE))
components(dcmp) |> autoplot()
```



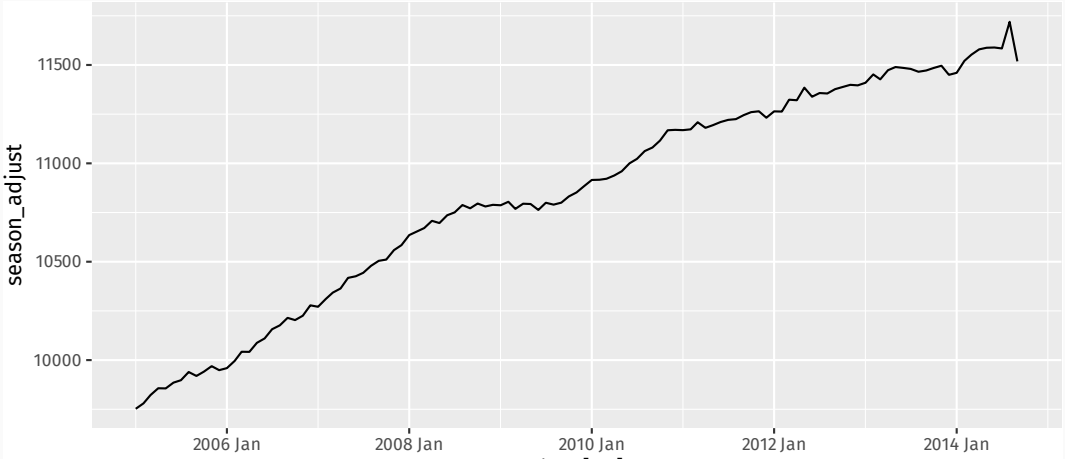
The ABS stuff-up

```
components(dcmp) |>
  filter(year(Time) == 2013) |>
  gg_season(season_year) +
  labs(title = "Seasonal component") + guides(colour = "none")
```



The ABS stuff-up

```
components(dcmp) |>
  as_tsibble() |>
  autoplot(season_adjust)
```



The ABS stuff-up

- August 2014 employment numbers higher than expected.
- Supplementary survey usually conducted in August for employed people.
- Most likely, some employed people were claiming to be unemployed in August to avoid supplementary questions.
- Supplementary survey not run in 2014, so no motivation to lie about employment.
- In previous years, seasonal adjustment fixed the problem.
- The ABS has now adopted a new method to avoid the bias.