

Rob J Hyndman  
George Athanasopoulos

# FORECASTING

## PRINCIPLES AND PRACTICE

A comprehensive introduction to the latest forecasting methods using R. Learn to improve your forecast accuracy using dozens of real data examples.



3RD EDITION

 **OTexts**  
Open Texts Publishing

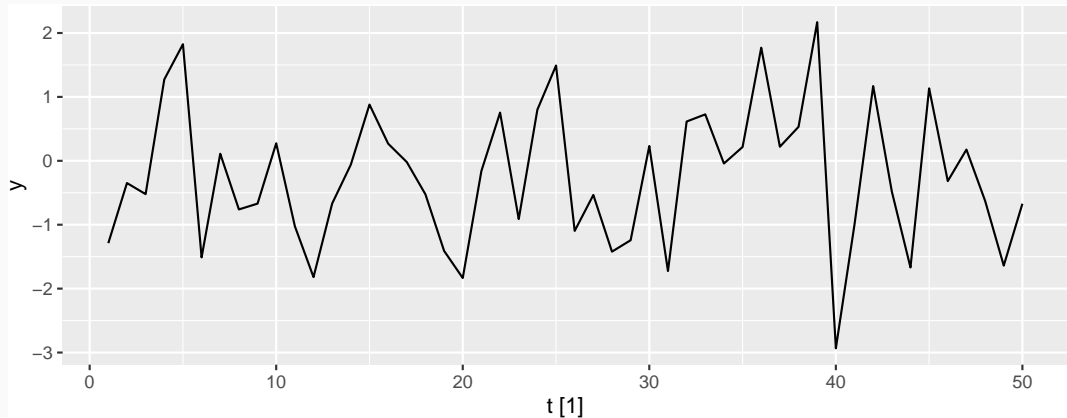
## 2. Time series graphics

2.9 White noise

[OTexts.org/fpp3/](https://OTexts.org/fpp3/)

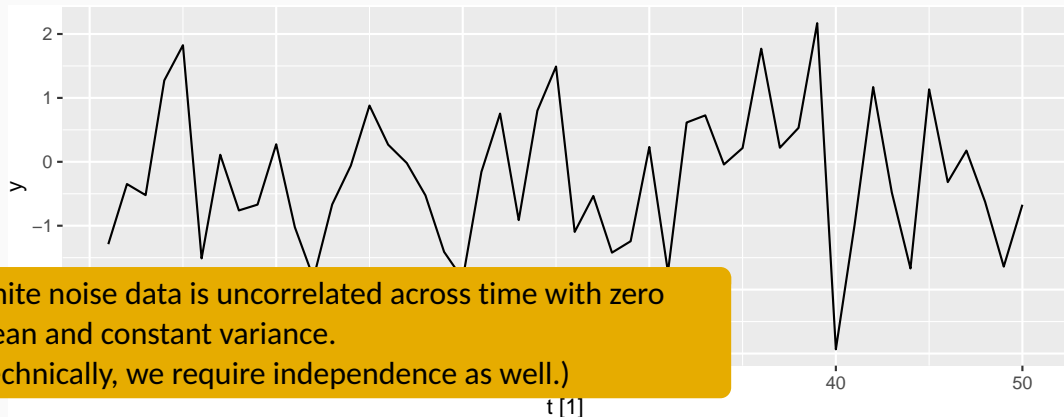
# Example: White noise

```
set.seed(30)
wn <- tsibble(t = 1:50, y = rnorm(50), index = t)
wn |> autoplot(y)
```



# Example: White noise

```
set.seed(30)
wn <- tsibble(t = 1:50, y = rnorm(50), index = t)
wn |> autoplot(y)
```

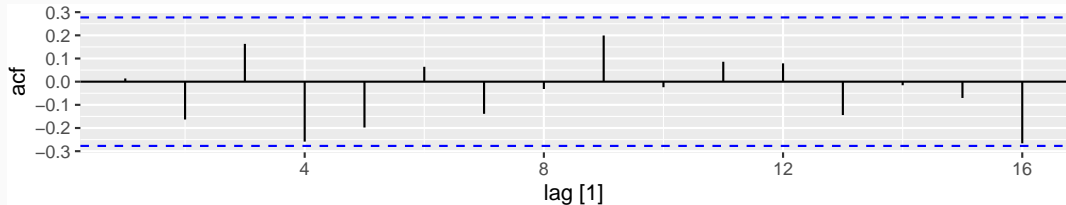


White noise data is uncorrelated across time with zero mean and constant variance.  
(Technically, we require independence as well.)

# Example: White noise

```
wn |> ACF(y)
```

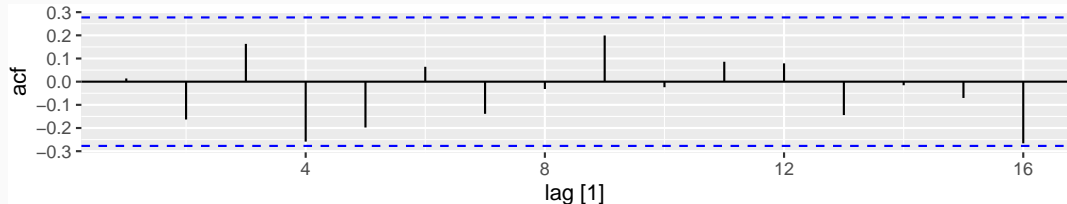
$r_1$	$r_2$	$r_3$	$r_4$	$r_5$	$r_6$	$r_7$	$r_8$	$r_9$	$r_{10}$
0.014	-0.163	0.163	-0.259	-0.198	0.064	-0.139	-0.032	0.199	-0.024



# Example: White noise

```
wn |> ACF(y)
```

$r_1$	$r_2$	$r_3$	$r_4$	$r_5$	$r_6$	$r_7$	$r_8$	$r_9$	$r_{10}$
0.014	-0.163	0.163	-0.259	-0.198	0.064	-0.139	-0.032	0.199	-0.024



- Sample autocorrelations for white noise series.
- Expect each autocorrelation to be close to zero.
- Blue lines show 95% critical values.

# Sampling distribution of autocorrelations

Sampling distribution of  $r_k$  for white noise data is asymptotically  $N(0, 1/T)$ .

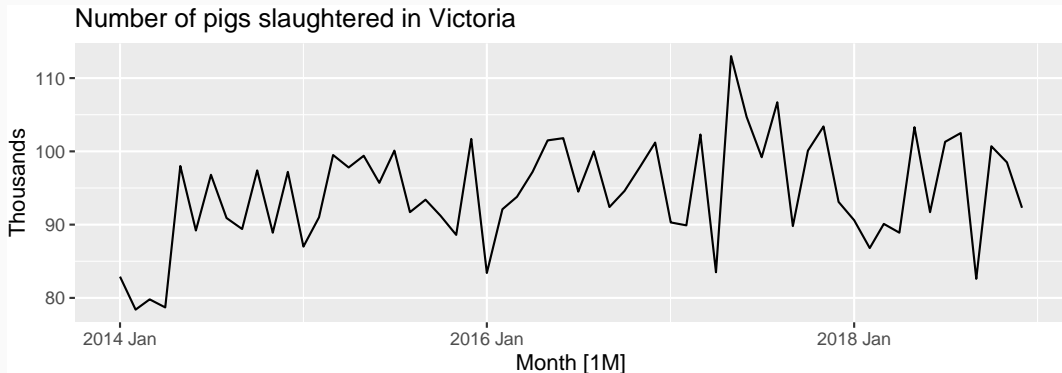
# Sampling distribution of autocorrelations

Sampling distribution of  $r_k$  for white noise data is asymptotically  $N(0, 1/T)$ .

- 95% of all  $r_k$  for white noise must lie within  $\pm 1.96/\sqrt{T}$ .
- If this is not the case, the series is probably not WN.
- Common to plot lines at  $\pm 1.96/\sqrt{T}$  when plotting ACF. These are the **critical values**.

# Example: Pigs slaughtered

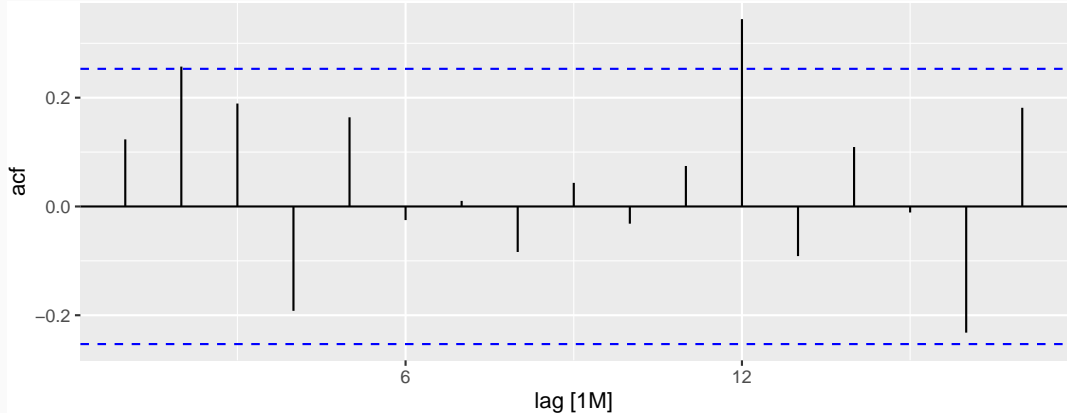
```
pigs <- aus_livestock |>  
  filter(State == "Victoria", Animal == "Pigs", year(Month) >= 2014)  
pigs |> autoplot(Count / 1e3) +  
  labs(y = "Thousands", title = "Number of pigs slaughtered in Victoria")
```





# Example: Pigs slaughtered

```
pigs |>  
  ACF(Count) |>  
  autoplot()
```



## Example: Pigs slaughtered

Monthly total number of pigs slaughtered in the state of Victoria, Australia, from January 2014 through December 2018 (Source: Australian Bureau of Statistics.)

## Example: Pigs slaughtered

Monthly total number of pigs slaughtered in the state of Victoria, Australia, from January 2014 through December 2018 (Source: Australian Bureau of Statistics.)

- Difficult to detect pattern in time plot.
- ACF shows significant autocorrelation for lag 2 and 12.
- Indicate some slight seasonality.

## Example: Pigs slaughtered

Monthly total number of pigs slaughtered in the state of Victoria, Australia, from January 2014 through December 2018 (Source: Australian Bureau of Statistics.)

- Difficult to detect pattern in time plot.
- ACF shows significant autocorrelation for lag 2 and 12.
- Indicate some slight seasonality.

These show the series is **not a white noise series**.