Time Series Forecasting

Chapter 3

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Simple Forecasting Methods

```
## Loading Packages
library("pacman")
p_load("fpp2")
```

```
## Average Method
y <- ts(c(123, 39, 78, 52, 110), start = 2012)
h <- 1
meanf(y, h)
```

```
##      Point Forecast    Lo 80    Hi 80     Lo 95   Hi 95
## 2017           80.4 19.74314 141.0569 -29.44201 190.242
```

```
## Usage of knitr for Rmd Tables
p_load("knitr")
kable(meanf(y, h))
```

	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
2017	80.4	19.74314	141.0569	-29.44201	190.242

```
## Naive Method
naive(y, h)
```

```
##      Point Forecast    Lo 80    Hi 80       Lo 95    Hi 95
## 2017            110 38.02459 181.9754 -0.07688897 220.0769
```

```
rwf(y, h) # Equivalent alternative
```

```
##      Point Forecast    Lo 80    Hi 80       Lo 95    Hi 95
## 2017            110 38.02459 181.9754 -0.07688897 220.0769
```

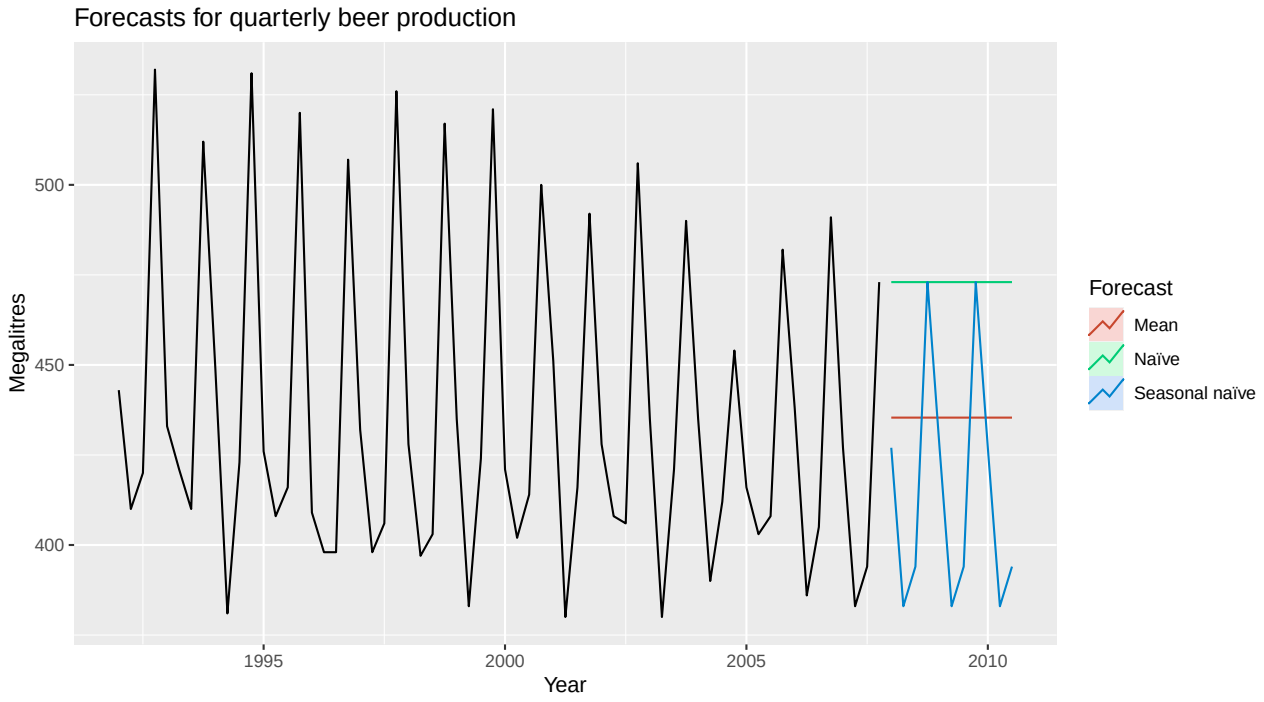
```
## Seasonal Naive
snaive(y, h)
```

```
##      Point Forecast    Lo 80    Hi 80       Lo 95    Hi 95
## 2017            110 38.02459 181.9754 -0.07688897 220.0769
```

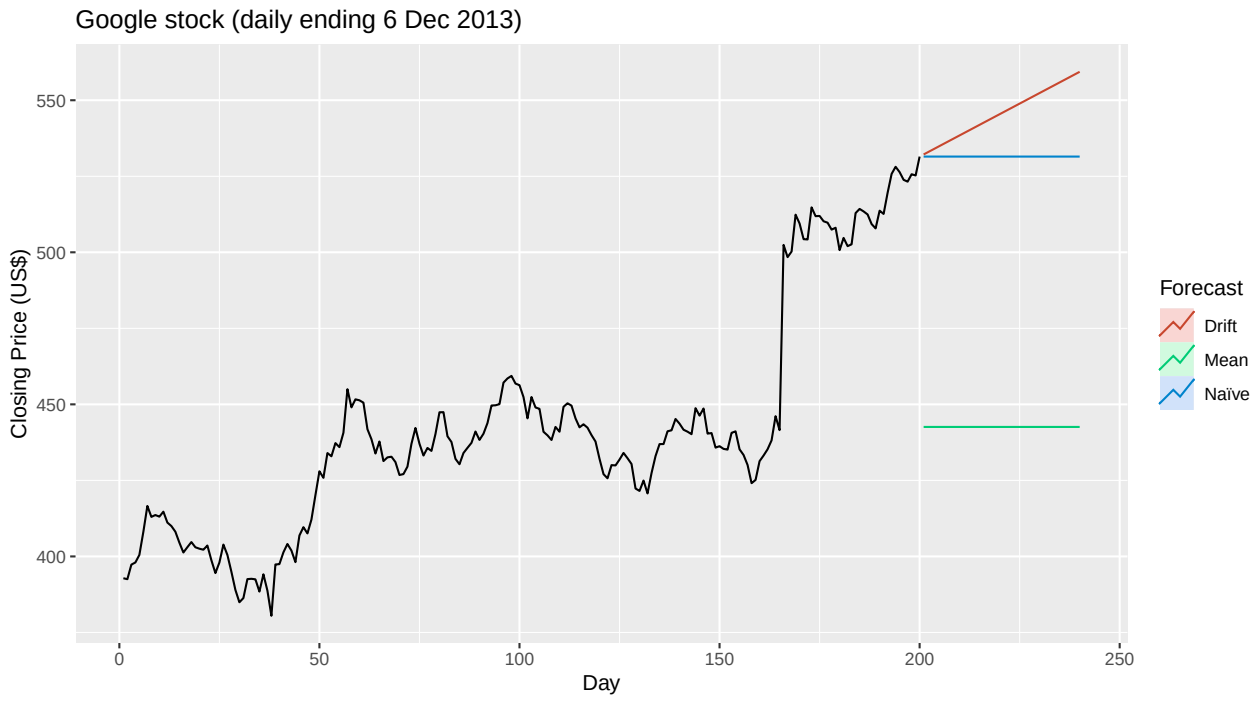
```
## Drift Method
rwf(y, h, drift = TRUE)
```

```
##      Point Forecast    Lo 80    Hi 80     Lo 95    Hi 95
## 2017         106.75 23.77923 189.7208 -20.14285 233.6428
```

```
# Set training data from 1992 to 2007
beer2 <- window(ausbeer, start = 1992, end = c(2007, 4))
# Plot some forecasts
autoplot(beer2) +
  autolayer(meanf(beer2, h = 11),
            series = "Mean", PI = FALSE) +
  autolayer(naive(beer2, h = 11),
            series = "Naïve", PI = FALSE) +
  autolayer(snaive(beer2, h = 11),
            series = "Seasonal naïve", PI = FALSE) +
  ggtitle("Forecasts for quarterly beer production") +
  xlab("Year") + ylab("Megalitres") +
  guides(colour = guide_legend(title = "Forecast"))
```



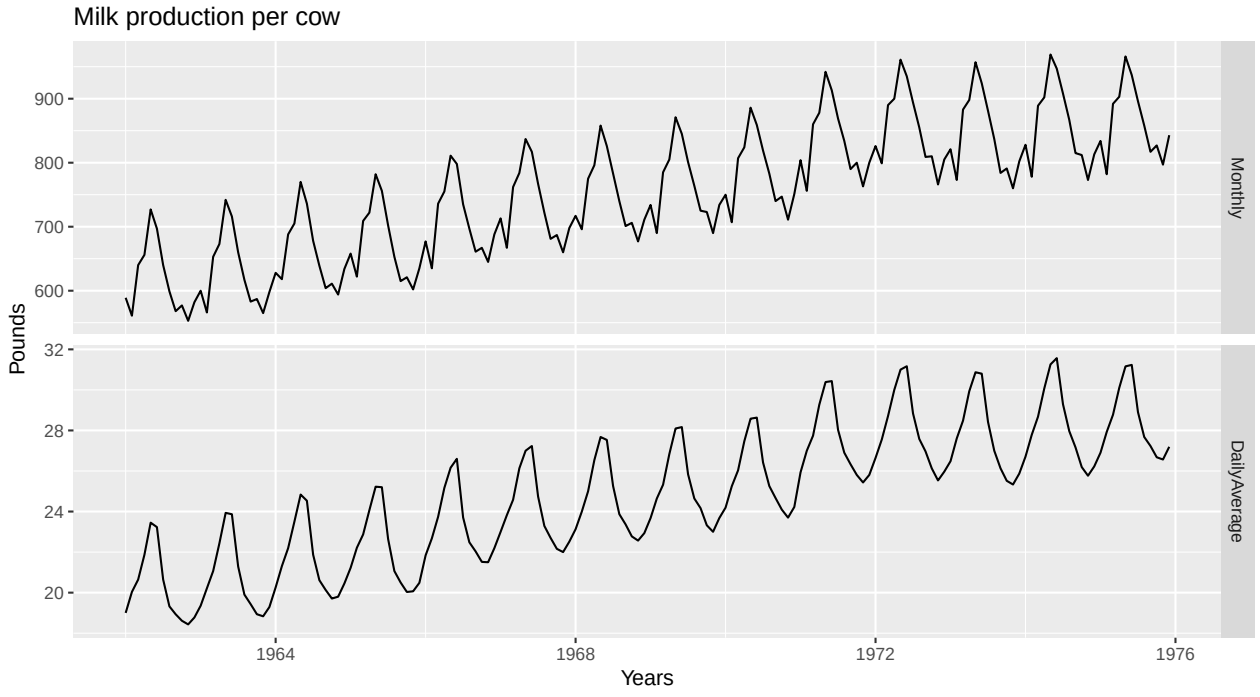

```
autoplot(goog200) +
  autolayer(meanf(goog200, h = 40),
            series = "Mean", PI = FALSE) +
  autolayer(rwf(goog200, h = 40),
            series = "Naïve", PI = FALSE) +
  autolayer(rwf(goog200, drift = TRUE, h = 40),
            series = "Drift",
            PI = FALSE) +
  ggtitle("Google stock (daily ending 6 Dec 2013)") +
  xlab("Day") + ylab("Closing Price (US$)") +
  guides(colour = guide_legend(title = "Forecast"))
```



Transformations and Adjustments

Calendar Adjustment

```
dframe <- cbind(Monthly = milk,
                DailyAverage = milk/monthdays(milk))
  autoplot(dframe, facet=TRUE) +
    xlab("Years") + ylab("Pounds") +
    ggtitle("Milk production per cow")
```

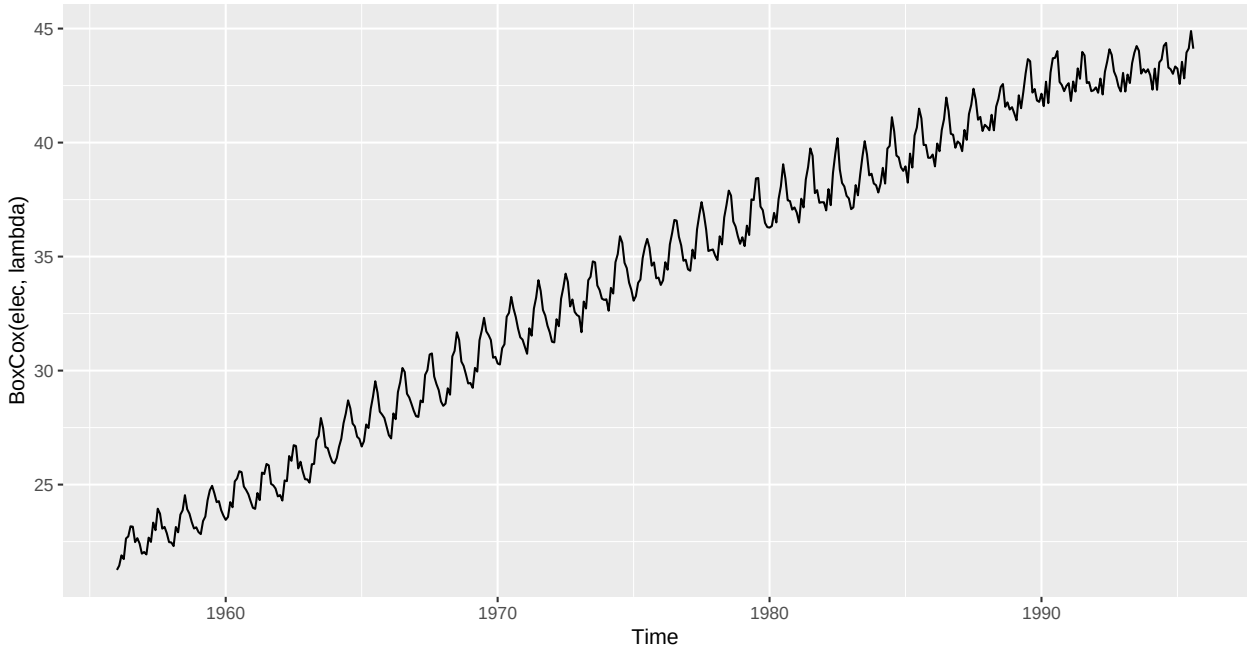


Mathematical Adjustments (Box-Cox Transformations)

```
(lambda <- BoxCox.lambda(elec))
```

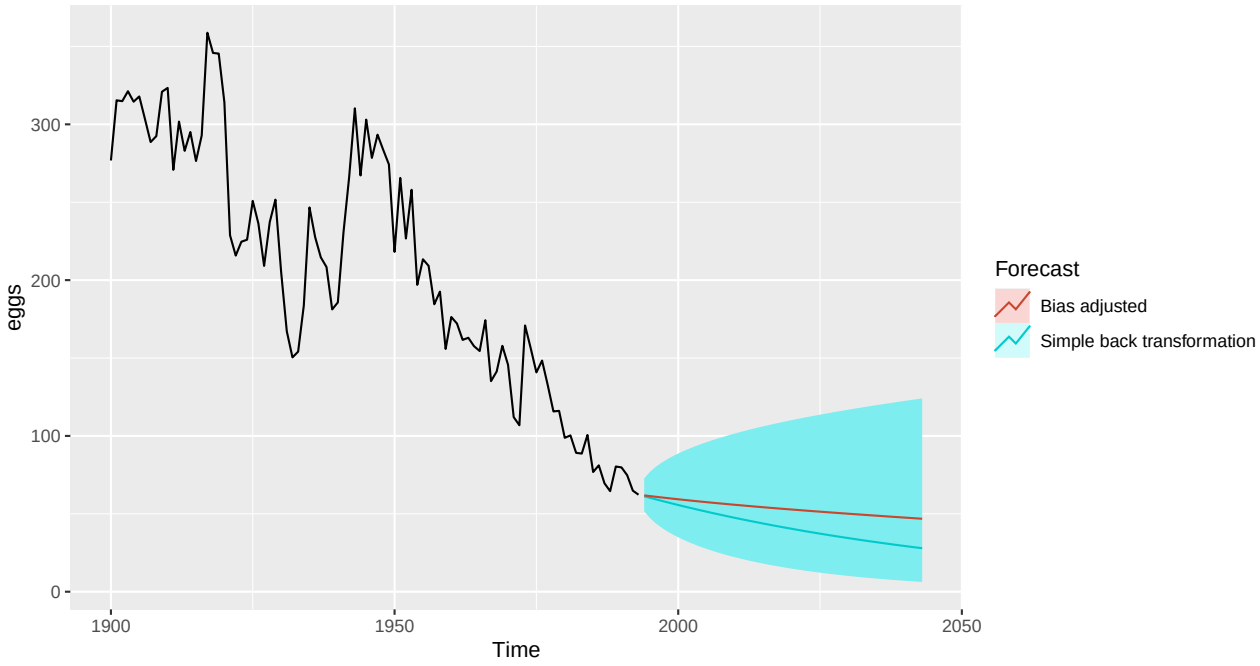
```
## [1] 0.2654076
```

```
autoplot(BoxCox(elec,lambda))
```



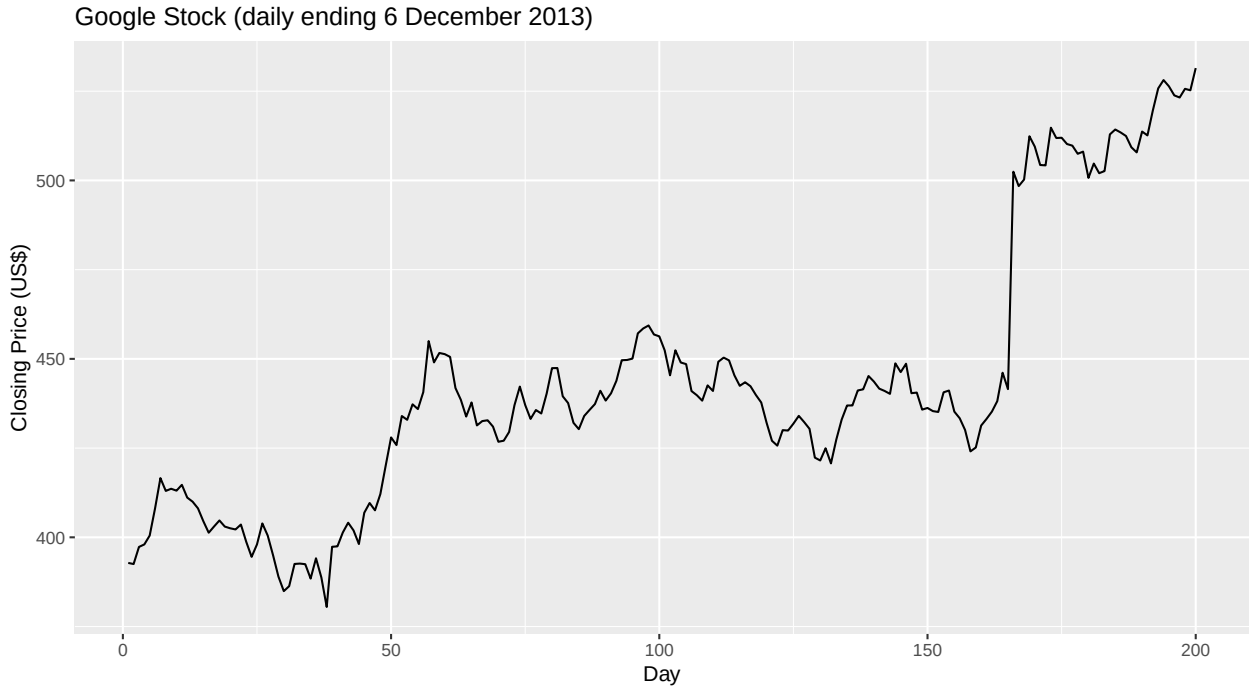
Bias Adjustments

```
fc <- rwf(eggs, drift=TRUE, lambda=0, h=50, level=80)
fc2 <- rwf(eggs, drift=TRUE, lambda=0, h=50, level=80,
  biasadj=TRUE)
autoplot(eggs) +
  autolayer(fc, series="Simple back transformation") +
  autolayer(fc2, series="Bias adjusted", PI=FALSE) +
  guides(colour=guide_legend(title="Forecast"))
```

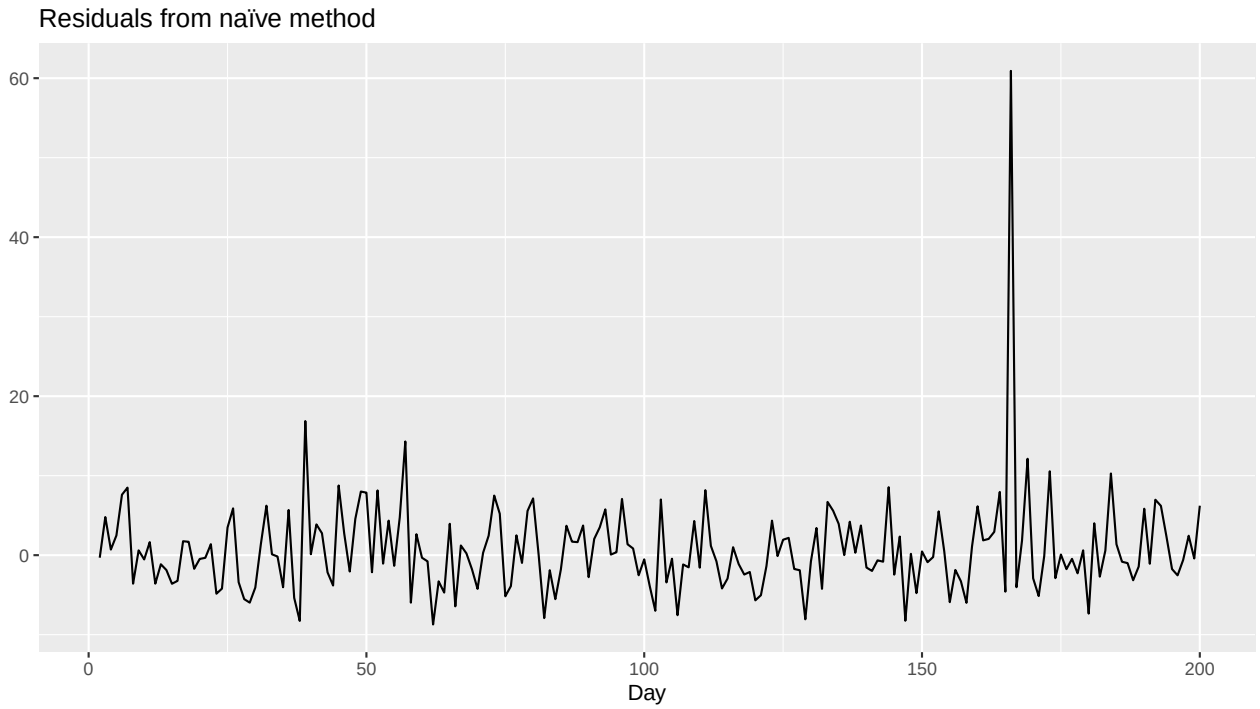


Residual Analysis

```
autoplot(goog200) +
  xlab("Day") + ylab("Closing Price (US$)") +
  ggtitle("Google Stock (daily ending 6 December 2013)")
```

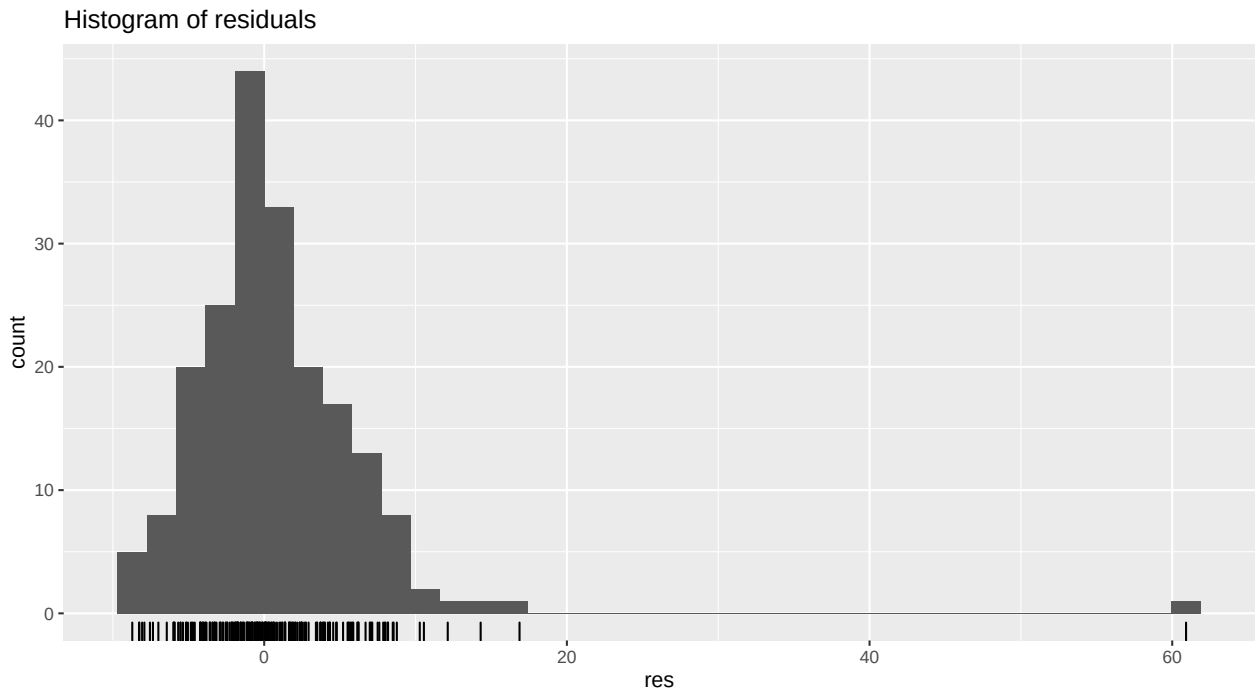



```
res <- residuals(naive(goog200))
autoplot(res) + xlab("Day") + ylab("") +
  ggtitle("Residuals from naïve method")
```

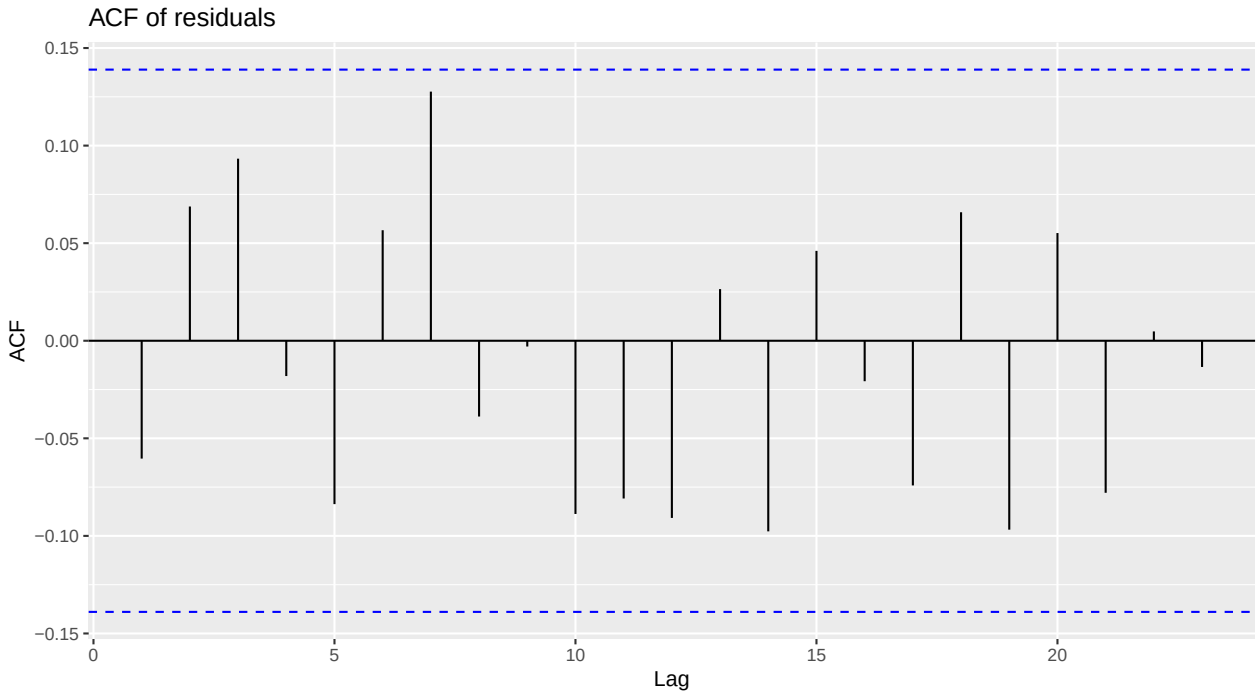



```
gghistogram(res) + ggtitle("Histogram of residuals")
```

```
## Warning: Removed 1 rows containing non-finite values (stat_bin).
```




```
ggAcf(res) + ggtitle("ACF of residuals")
```



Portmanteau Tests for Autocorrelation

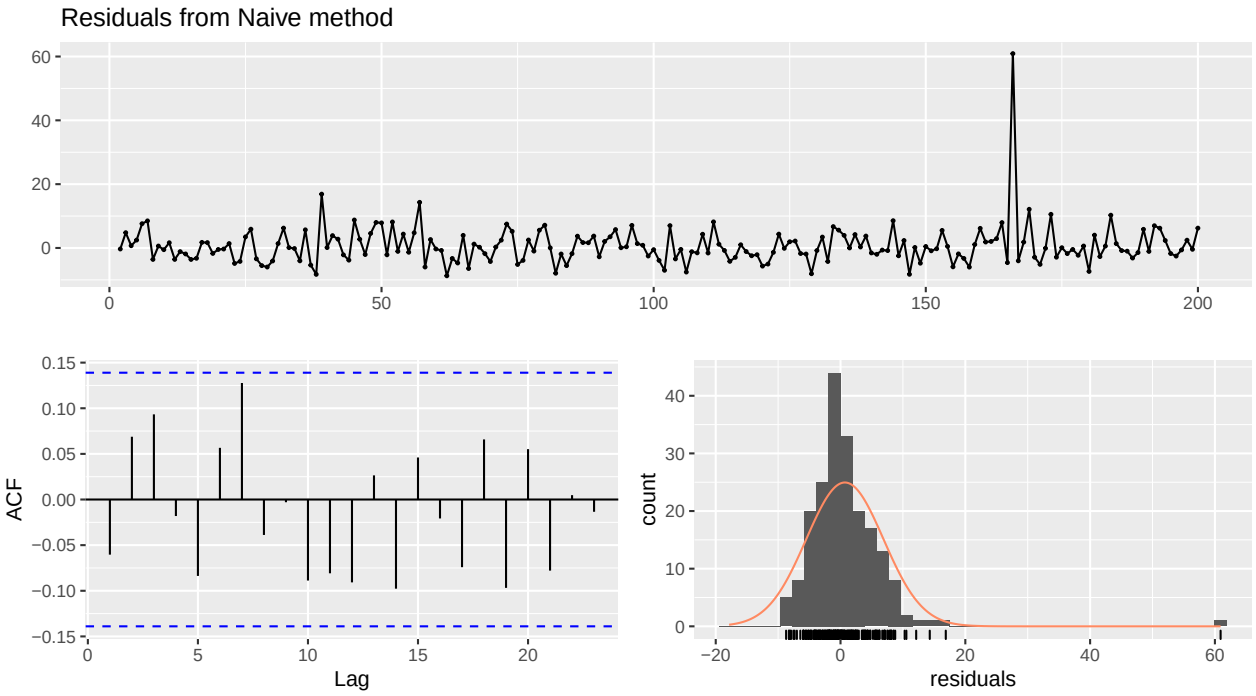
```
Box.test(res, lag=10, fitdf=0)
```

```
##
##  Box-Pierce test
##
## data:  res
## X-squared = 10.611, df = 10, p-value = 0.3886
```

```
Box.test(res,lag=10, fitdf=0, type="Lj")
```

```
##
##  Box-Ljung test
##
## data:  res
## X-squared = 11.031, df = 10, p-value = 0.3551
```

```
checkresiduals(naive(goog200))
```




```
##
##  Ljung-Box test
##
## data:  Residuals from Naive method
## Q* = 11.031, df = 10, p-value = 0.3551
##
## Model df: 0.   Total lags used: 10
```