Homework 5

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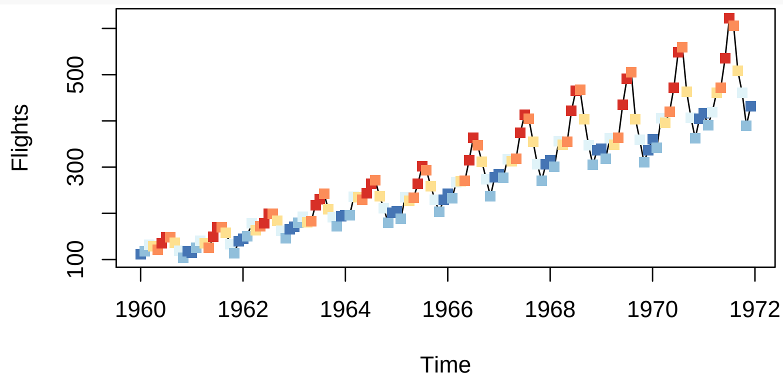
1. (Cryer & Chan, Exercise 5.2)
2. (Cryer & Chan, Exercise 5.13)
   a. The following R code produces a time series plot of the data:

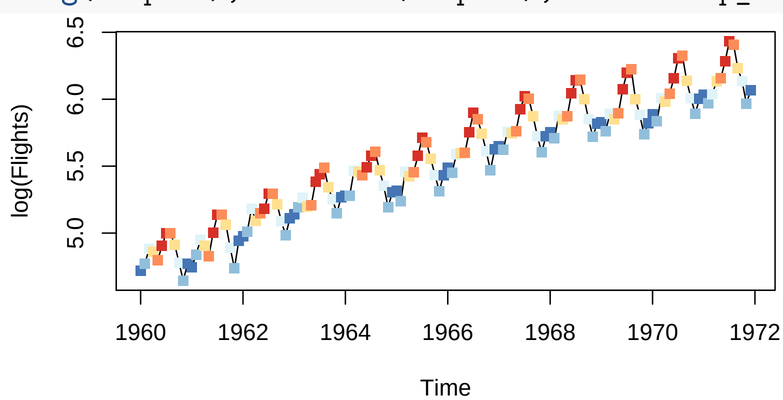
```
temp_color = c(rev(brewer.pal(6, 'RdYlBu')), brewer.pal(6, 'RdYlBu'))

plot(airpass, ylab = "Flights", type = "l")
points(y = airpass, x = time(airpass), col = temp_color, pch = 15)
```



The plot seems to indicate a strong seasonal trend in the time series, with more flights in the warmer months than in the colder months. Moreover, the mean number of flights per year is steadily increasing over the whole time span of the series, as well as the variability in monthly flights within a given year – later years display considerably more variability than earlier years in the series.

   b. The following R code produces a time series plot of the log-transformed series:

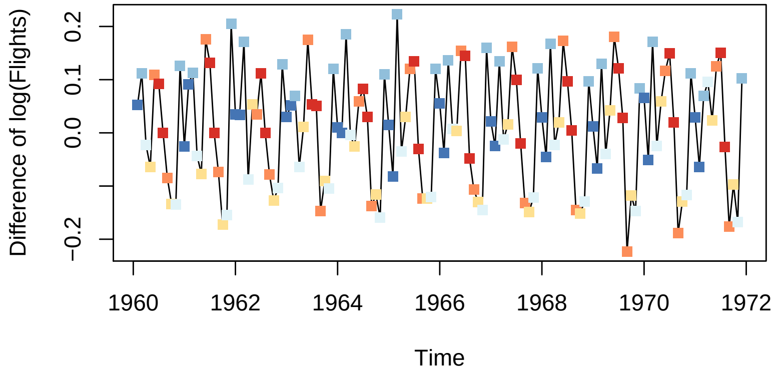
```
plot(log(airpass), ylab = "log(Flights)", type = "l")
points(y = log(airpass), x = time(airpass), col = temp_color, pch = 15)
```



The log transformation seems to have considerably dampened the yearly variability in the series. However, as in the untransformed case, the yearly means of the transformed data are steadily increasing, and the series displays the same seasonal trend.

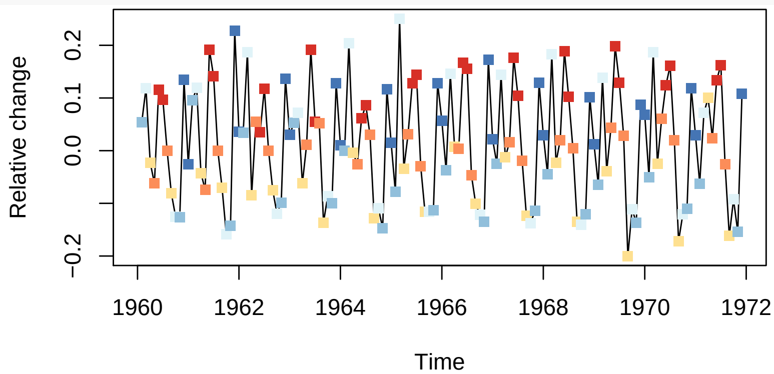
c. The following R code produces a time series plot of the differences of the log-transformed data:

```
diff_log <- diff(log(airpass))
plot(diff_log, ylab = "Difference of log(Flights)", type = "l")
points(y = diff_log, x = time(diff_log), col = temp_color, pch = 15)
```



Next, we have a time series plot of the (fractional) relative differences:

```
rel_change <- (airpass / zlag(airpass)) - 1
plot(rel_change, ylab = "Relative change", type = "l")
points(y = rel_change, x = time(rel_change), col = temp_color, pch = 15)
```



The two plots seem to display the same, relatively stable trend. Assuming the true model is of the form

$$Y_t = (1 + X_t)Y_{t-1},$$

with $|X_t|$ small for every t, then

$$\nabla \log Y_t = \log\left(\frac{Y_t}{Y_{t-1}}\right) = \log(1 + X_t) \approx X_t$$

for every t. Moreover,

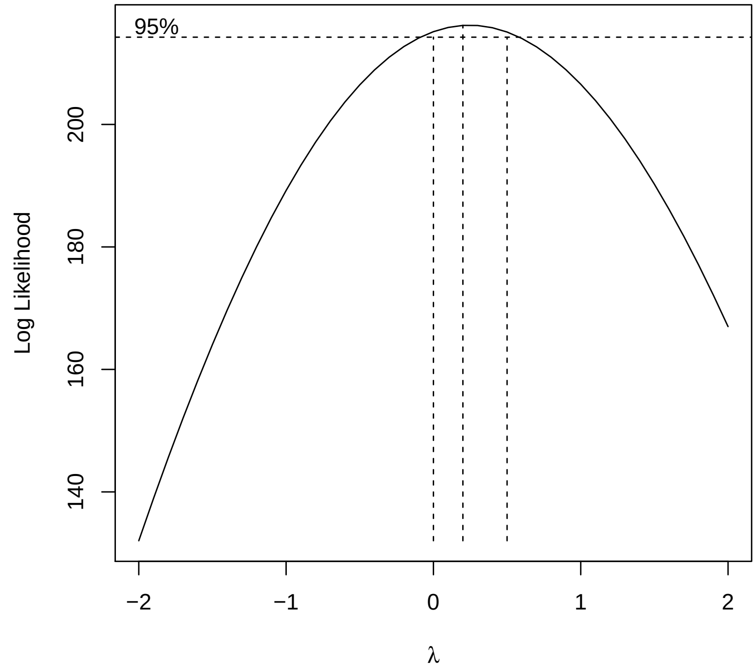
$$\frac{Y_t - Y_{t-1}}{Y_{t-1}} = \frac{Y_t}{Y_{t-1}} - 1 = (1 + X_t) - 1 = X_t.$$

Thus, under this model, we would expect the two plots to look about the same.

3. (Cryer & Chan, Exercise 5.14)

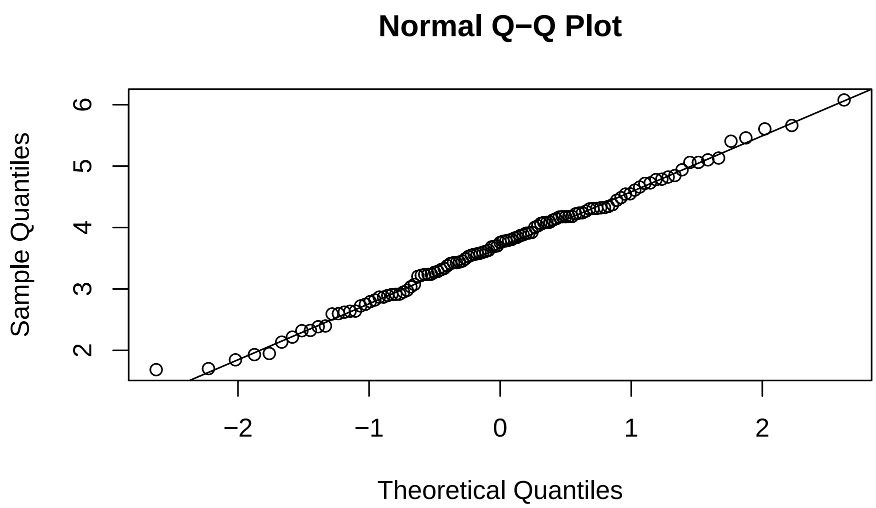
a.

```r
BoxCox.ar(larain)
```



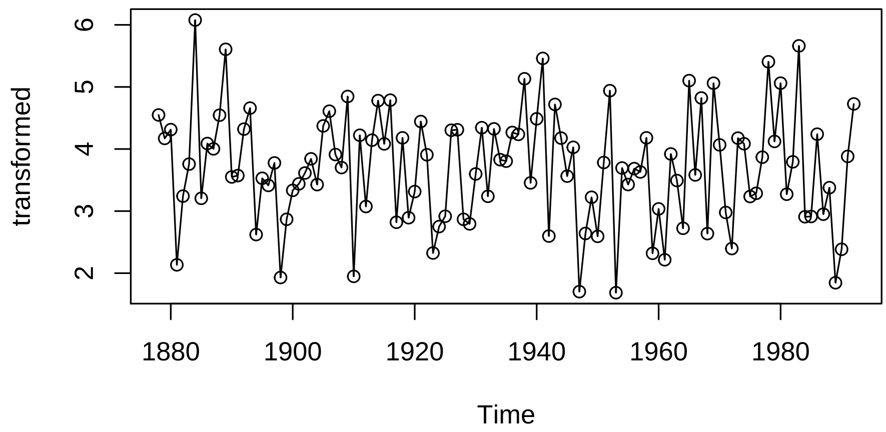
b.

```r
lambda <- 0.25
transformed <- (larain^lambda - 1) / lambda
qqnorm(transformed)
qqline(transformed)
```



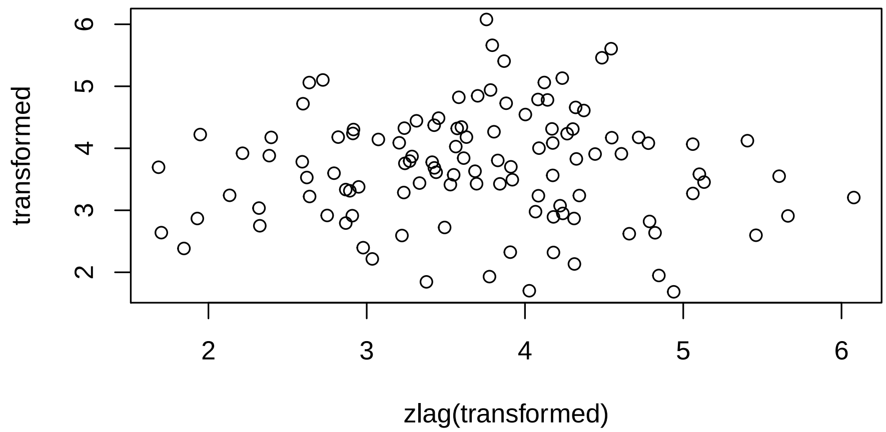
c.

```r
plot(transformed, type = "o")
```



d.

```r
plot(y = transformed, x = zlag(transformed))
```



4.

5.