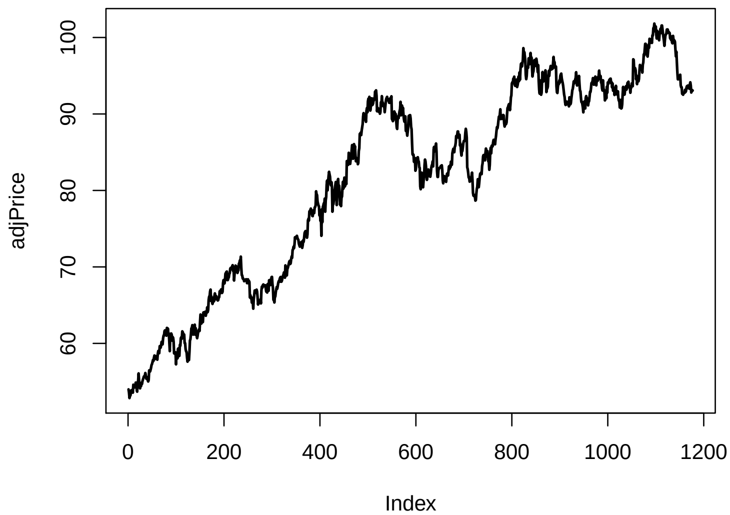
Solutions to Selected Computer Lab Problems and Exercises in Chapter 4 of *Statistics and Data Analysis for Financial Engineering, 2nd ed.* by David Ruppert and David S. Matteson

Problem 9. The plot shows no tendency to revert to a mean so the series is nonstationary.

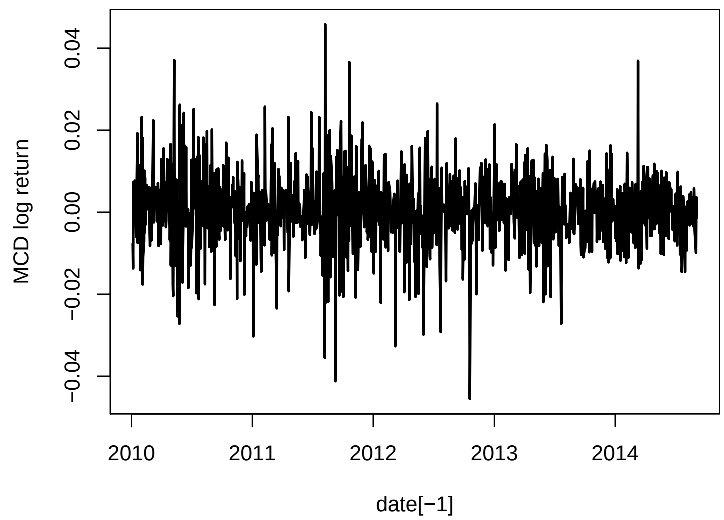


Problem 10. The code to product the plot and the plot itself are below. The plot looks stationary. There appears to be volatility clustering, but that is not a sign of nonstationarity.

The function `as.Date()` is used to convert the first column of the data from class `factor` (that is, a character variable) to class `date`. The format `%m/%d/%Y` indicates that date is in the form month, day, and 4-digit year. (A lower case "y" would indicate a 2-digit year.) Without this conversion, the x-axis would not be labeled correctly and the plot would have other problems as well.

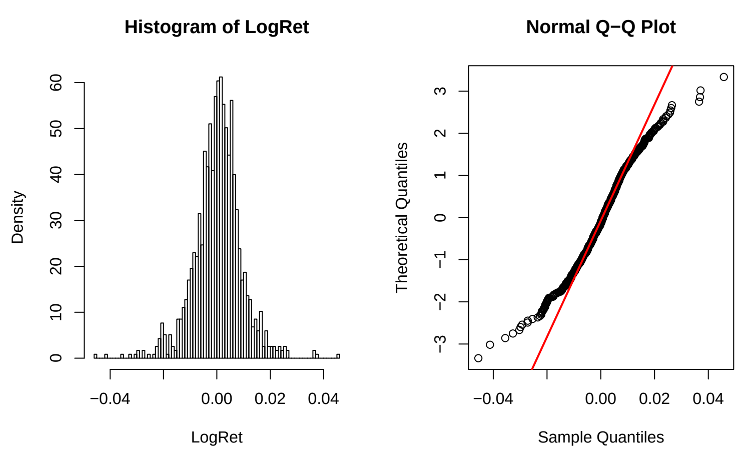
See `http://www.statmethods.net/input/dates.html` for more information about `as.Date()`.

```
n = length(adjPrice)
LogRet = log(adjPrice[-1]/adjPrice[-n])
date = as.Date(data[,1],"%m/%d/%Y")
pdf("mcd02.pdf",width = 6, height = 5)
plot(date[-1],LogRet, ylab = "MCD log return",type="l",lwd=2)
graphics.off()
```



Problem 11. The code to create the plot and the plot are below.

```
par(mfrow=c(1,2))
hist(LogRet, 80, freq = FALSE)
qqnorm(LogRet,datax=TRUE)
qqline(LogRet,datax=TRUE,col="red",lwd=2)
```



The QQ plot shows heavier than Gaussian tails and the heavy tails show up on the histogram as bins that are somewhat detached from the bulk of the data. Therefore, the log returns do not appear Gaussian. However, they appear nearly symmetric, except that the left tail might be very slightly elongated compared to the right tail.

Exercise 6. (a) $\Phi^{-1}(0.975) = 1.96$ because Φ is the cumulative distribution function of the $N(0,1)$ distribution which is symmetric about 0. Therefore, if the probability below -1.96 is 0.025, then the probability above 1.96 is also 0.025, so that 1.96 is the 0.975 quantile.

(b) $-1 + (\sqrt{2})(1.96)$.

Exercise 7. The infinum of the approximate variance is 0 and is obtained in the limit as $q \to 0$ or 1.

Another interesting question is which quantile has the largest approximate variance:

The 0.5-quantile, which is also the median, has the largest approximate variance since the denominator in (4.3) is constant, because f is constant, and the numerator is maximized at $q = 0.5$, as a simple calculus argument shows.