

zoo Quick Reference

Ajay Shah

Ministry of Finance, New Delhi

Achim Zeileis

Wirtschaftsuniversität Wien

Gabor Grothendieck

GKX Associates Inc.

Abstract

This vignette gives a brief overview of (some of) the functionality contained in **zoo** including several nifty code snippets when dealing with (daily) financial data. For a more complete overview of the package's functionality and extensibility see [Zeileis and Grothendieck \(2005\)](#) (contained as vignette "zoo" in the package), the manual pages and the reference card.

Keywords: irregular time series, daily data, weekly data, returns.

Read a series from a text file

To read in data in a text file, `read.table()` and associated functions can be used as usual with `zoo()` being called subsequently. The convenience function `read.zoo` is a simple wrapper to these functions that assumes the index is in the first column of the file and the remaining columns are data.

Data in `demo1.txt`, where each row looks like

```
23 Feb 2005|43.72
```

can be read in via

```
R> inrusd <- read.zoo("demo1.txt", sep = "|", format = "%d %b %Y")
```

The `format` argument causes the first column to be transformed to an index of class "Date".

The data in `demo2.txt` look like

```
Daily,24 Feb 2005,2055.30,4337.00
```

and requires more attention because of the format of the first column.

```
R> tmp <- read.table("demo2.txt", sep = ",")
R> z <- zoo(tmp[, 3:4], as.Date(as.character(tmp[, 2]), format = "%d %b %Y"))
R> colnames(z) <- c("Nifty", "Junior")
```

Query dates

To return all dates corresponding to a series `index(z)` or equivalently

```
R> time(z)
```

```
[1] "2005-02-10" "2005-02-11" "2005-02-14" "2005-02-15" "2005-02-17"
[6] "2005-02-18" "2005-02-21" "2005-02-22" "2005-02-23" "2005-02-24"
[11] "2005-02-25" "2005-02-28" "2005-03-01" "2005-03-02" "2005-03-03"
[16] "2005-03-04" "2005-03-07" "2005-03-08" "2005-03-09" "2005-03-10"
```

can be used. The first and last date can be obtained by

```
R> start(z)

[1] "2005-02-10"

R> end(inrusd)

[1] "2005-03-10"
```

Convert back into a plain matrix

To strip off the dates and just return a plain vector/matrix `coredata` can be used

```
R> plain <- coredata(z)
R> str(plain)

num [1:20, 1:2] 2063 2082 2098 2090 2062 ...
- attr(*, "dimnames")=List of 2
..$ : chr [1:20] "1" "2" "3" "4" ...
..$ : chr [1:2] "Nifty" "Junior"
```

Union and intersection

Unions and intersections of series can be computed by `merge`. The intersection are those days where both series have time points:

```
R> m <- merge(inrusd, z, all = FALSE)
```

whereas the union uses all dates and fills the gaps where one series has a time point but the other does not with NAs (by default):

```
R> m <- merge(inrusd, z)
```

`cbind(inrusd, z)` is almost equivalent to the `merge` call, but may lead to inferior naming in some situations hence `merge` is preferred

To combine a series with its lag, use

```
R> merge(inrusd, lag(inrusd, -1))
```

```
           inrusd lag(inrusd, -1)
2005-02-10 43.78      NA
2005-02-11 43.79  43.78
2005-02-12   NA  43.79
2005-02-14 43.72      NA
2005-02-15 43.76  43.72
2005-02-16 43.82  43.76
2005-02-17 43.74  43.82
2005-02-18 43.84  43.74
2005-02-19   NA  43.84
2005-02-21 43.82      NA
2005-02-22 43.72  43.82
2005-02-23 43.72  43.72
2005-02-24 43.70  43.72
2005-02-25 43.69  43.70
```

```

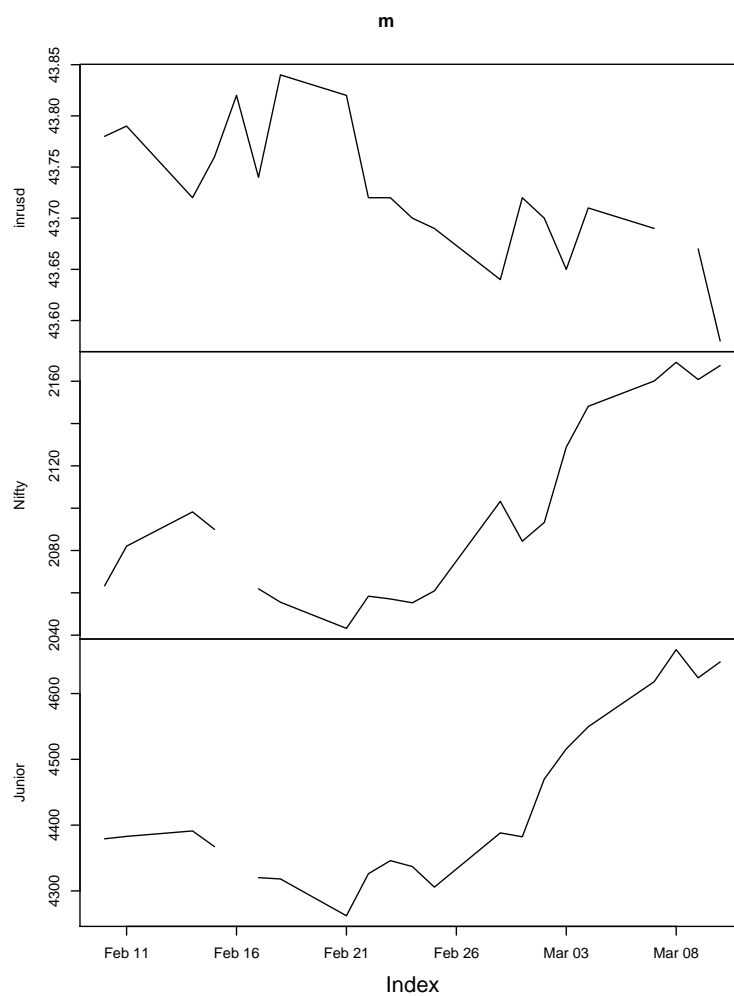
2005-02-26    NA  43.69
2005-02-28  43.64    NA
2005-03-01  43.72  43.64
2005-03-02  43.70  43.72
2005-03-03  43.65  43.70
2005-03-04  43.71  43.65
2005-03-05    NA  43.71
2005-03-07  43.69    NA
2005-03-08    NA  43.69
2005-03-09  43.67    NA
2005-03-10  43.58  43.67
2005-03-11    NA  43.58

```

Visualization

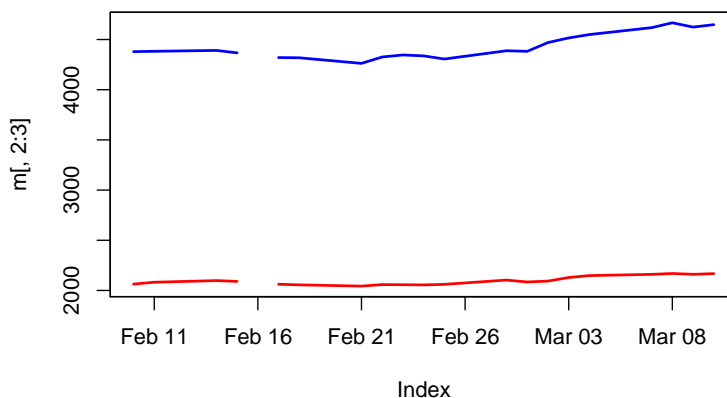
By default, the `plot` method generates a graph for each series in `m`

```
R> plot(m)
```



but several series can also be plotted in a single window.

```
R> plot(m[, 2:3], plot.type = "single", col = c("red", "blue"),
+       lwd = 2)
```



Select (a few) observations

Selections can be made for a range of dates of interest

```
R> window(z, start = as.Date("2005-02-15"), end = as.Date("2005-02-28"))
```

	Nifty	Junior
2005-02-15	2089.95	4367.25
2005-02-17	2061.90	4320.15
2005-02-18	2055.55	4318.15
2005-02-21	2043.20	4262.25
2005-02-22	2058.40	4326.10
2005-02-23	2057.10	4346.00
2005-02-24	2055.30	4337.00
2005-02-25	2060.90	4305.75
2005-02-28	2103.25	4388.20

and also just for a single date

```
R> m[as.Date("2005-03-10")]
```

	inrusd	Nifty	Junior
2005-03-10	43.58	2167.40	4648.05

Handle missing data

Various methods for dealing with NAs are available, including linear interpolation

```
R> interpolated <- na.approx(m)
```

‘last observation carried forward’,

```
R> m <- na.locf(m)
```

```
R> m
```

	inrusd	Nifty	Junior
2005-02-10	43.78	2063.35	4379.20
2005-02-11	43.79	2082.05	4382.90
2005-02-14	43.72	2098.25	4391.15
2005-02-15	43.76	2089.95	4367.25
2005-02-16	43.82	2089.95	4367.25
2005-02-17	43.74	2061.90	4320.15
2005-02-18	43.84	2055.55	4318.15
2005-02-21	43.82	2043.20	4262.25
2005-02-22	43.72	2058.40	4326.10
2005-02-23	43.72	2057.10	4346.00
2005-02-24	43.70	2055.30	4337.00
2005-02-25	43.69	2060.90	4305.75
2005-02-28	43.64	2103.25	4388.20
2005-03-01	43.72	2084.40	4382.25
2005-03-02	43.70	2093.25	4470.00
2005-03-03	43.65	2128.85	4515.80
2005-03-04	43.71	2148.15	4549.55
2005-03-07	43.69	2160.10	4618.05
2005-03-08	43.69	2168.95	4666.70
2005-03-09	43.67	2160.80	4623.85
2005-03-10	43.58	2167.40	4648.05

and others.

Prices and returns

To compute log-difference returns in %, the following convenience function is defined

```
R> prices2returns <- function(x) 100 * diff(log(x))
```

which can be used to convert all columns (of prices) into returns.

```
R> r <- prices2returns(m)
```

A 10-day rolling window standard deviations (for all columns) can be computed by

```
R> rapply(r, width = 10, FUN = sd)
```

	inrusd	Nifty	Junior
2005-02-18	0.1484024	0.6827704	0.7022275
2005-02-22	0.1497484	0.6168169	0.9586918
2005-02-23	0.1516702	0.8414873	0.9659141
2005-02-24	0.1517071	0.8838981	0.9710362
2005-02-25	0.1389399	0.7149261	0.8474269
2005-03-01	0.1160404	0.7217292	0.9557652
2005-03-02	0.1117103	0.7051424	0.8886226

To go from a daily series to the series of just the last-traded-day of each month `aggregate` can be used

```
R> prices2returns(aggregate(m, as.yearmon, tail, 1))
```

	inrusd	Nifty	Junior
Mar 2005	-0.1375831	3.0044525	5.7528657

Analogously, the series can be aggregated to the last-traded-day of each week employing a convenience function `nextfri` that computes for each "Date" the next friday.

```
R> nextfri <- function(x) 7 * ceiling(as.numeric(x - 1)/7) + as.Date(1)
R> prices2returns(aggregate(na.locf(m), nextfri, tail, 1))
```

	inrusd	Nifty	Junior
2005-02-18	0.11411618	-1.28095332	-1.48835360
2005-02-25	-0.34273997	0.25993286	-0.28757311
2005-03-04	0.04576659	4.14642260	5.50769882
2005-03-11	-0.29785794	0.89212859	2.14194498

Query Yahoo! Finance

When connected to the internet, Yahoo! Finance can be easily queried using the `get.hist.quote` function in

```
R> library("tseries")
```

From version 0.9-30 on, `get.hist.quote` by default returns "zoo" series with a "Date" attribute (in previous versions these had to be transformed from "ts" 'by hand').

A daily series can be obtained by:

```
R> sunw <- get.hist.quote(instrument = "SUNW", start = "2004-01-01",
+   end = "2004-12-31")
```

A monthly series can be obtained and transformed by

```
R> sunw2 <- get.hist.quote(instrument = "SUNW", start = "2004-01-01",
+   end = "2004-12-31", compression = "m", quote = "Close")
```

Here, "yearmon" dates might be even more useful:

```
R> time(sunw2) <- as.yearmon(time(sunw2))
```

The same series can equivalently be computed from the daily series via

```
R> sunw3 <- aggregate(sunw[, "Close"], as.yearmon, tail, 1)
```

The corresponding returns can be computed via

```
R> r <- prices2returns(sunw3)
```

where `r` is still a "zoo" series.

Query Oanda

Similarly you can obtain historical exchange rates from <http://www.oanda.com/> using `get.hist.quote`.

A daily series of EUR/USD exchange rates can be queried by

```
R> eur.usd <- get.hist.quote(instrument = "EUR/USD", provider = "oanda",
+   start = "2004-01-01", end = "2004-12-31")
```

This contains the exchange rates for every day in 2004. However, it is common practice in many situations to exclude the observations from weekends. To do so, we write a little convenience function which can determine for a vector of "Date" observations whether it is a weekend or not

```
R> is.weekend <- function(x) ((as.numeric(x) - 2)%%7) < 2
```

Based on this we can omit all observations from weekends

```
R> eur.usd <- eur.usd[!is.weekend(time(eur.usd))]
```

The function `is.weekend` introduced above exploits the fact that a "Date" is essentially the number of days since 1970-01-01, a Thursday. A more intelligible function which yields identical results could be based on the "POSIXlt" class

```
R> is.weekend <- function(x) {  
+   x <- as.POSIXlt(x)  
+   x$wday > 5 | x$wday < 1  
+ }
```

References

Zeileis A, Grothendieck G (2005). "zoo: S3 Infrastructure for Regular and Irregular Time Series." *Journal of Statistical Software*, **14**(6), 1–27. URL <http://www.jstatsoft.org/v14/i06/>.