



MANIPULATING TIME SERIES DATA IN R WITH XTS & ZOO

Welcome to the course

About myself

- Creator & co-creator of a variety of packages:
 - xts
 - quantmod
 - zoo
- Co-founded R/Finance conference
 - <http://www.rinfinance.com>

Course Overview

- Chapter 1: Create, import, and export time series
- Chapter 2: Subsetting, extraction, and more
- Chapter 3: Merging & modifying time series
- Chapter 4: Apply and aggregate by time period(s)
- Chapter 5: Advanced and extra features of xts



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Let's practice!

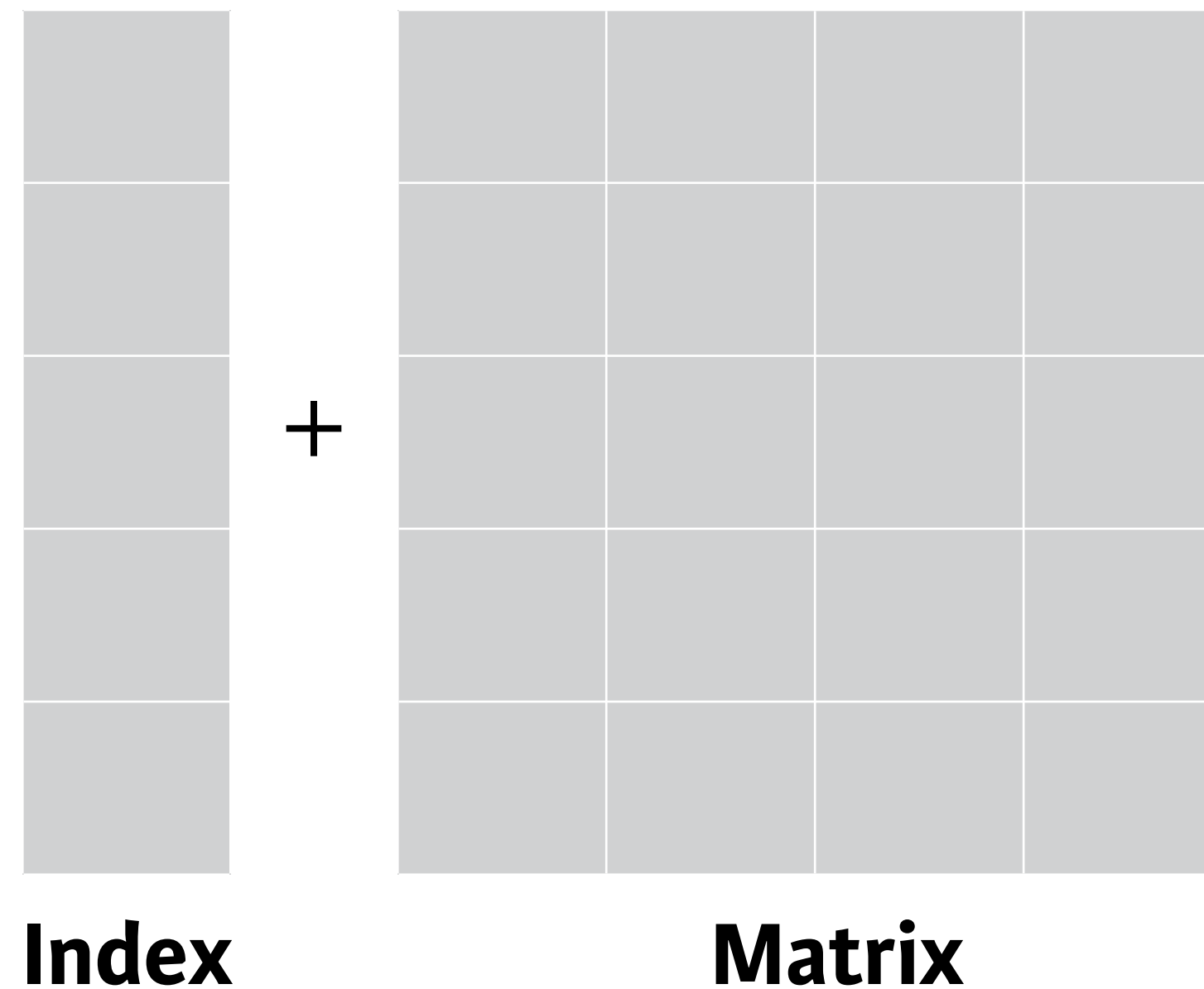


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Introducing **`xts` and `zoo` objects**

What is xts?

- eXtensible Time Series
- An extended zoo object
- Matrix + Index
- Observations + Times



An xts example

```
> # xts = matrix + index
```

```
> x <- matrix(1:4, ncol = 2, nrow = 2)
```

```
> x
      [,1] [,2]
[1,]    1    3
[2,]    2    4
```

```
> idx <- as.Date(c("2015-01-01", "2015-02-01"))
```

```
> idx
[1] "2015-01-01" "2015-02-01"
```

- Class: Date, POSIX times, timeDate, chron,...

An xts example

```
> # xts = matrix + index  
  
> X <- xts(x, order.by = idx)  
> X  
           [,1] [,2]  
2015-01-01     1     3  
2015-02-01     2     4
```


The xts constructor

```
xts(x = NULL,  
    order.by = index(x),  
    frequency = NULL,  
    unique = NULL,  
    tzone = Sys.getenv("TZ"))
```

- tzone specifies the time zone of your series
- unique forces times to be unique
- The index is increasing order of time

An xts example

```
> # xts = matrix + index  
  
> x <- xts(x, order.by = idx)  
> x
```

	[,1]	[,2]
2015-01-01	1	3
2015-02-01	2	4

Special `xts` behavior

- `xts` is a matrix with associated times for each observation
- Subsets preserve matrix form
- Attributes are preserved
 - i.e. a time-stamp that was acquired
- `xts` is a subclass of `zoo`

Deconstructing xts

- Use internal components
- `coredata()` is used to extract the data component

```
coredata(x, fmt = FALSE)
```

- `index()` is used to extract the index a.k.a. times

```
index(x)
```



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Importing, exporting and converting time series

Reality check

- Data usually already exists, and needs wrangling
 - Often data isn't in your preferred class
- Data needs to be imported into R and converted to `xts`
- You will convert, read and export `xts` objects

Converting using `as.xts()`

```
# Load data from R datasets
> data(sunspots)
> class(sunspots)
[1] "ts"

> sunspots_xts <- as.xts(sunspots)
> class(sunspots_xts)
[1] "xts" "zoo"
```

```
> head(sunspots_xts)
      [,1]
Jan 1749 58.0
Feb 1749 62.6
Mar 1749 70.0
Apr 1749 55.7
May 1749 85.0
Jun 1749 83.5
```


Importing external data to xts

- Read data into R using built in (or external) functions
 - i.e. `read.table()`, `read.csv()`, and `read.zoo()`
- Coerce data to xts using `as.xts()`

```
> as.xts(read.table("file"))  
> as.xts(read.zoo("file"))
```

Exporting xts from R

- Sometimes you will need your data outside of R
- Use `write.zoo()` for external use (i.e. text files)

```
> write.zoo(x, "file")
```

- Use `saveRDS()` for R use

```
> saveRDS(x, "file")
```



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