

# Computing Returns

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In the simplest case, the function returns takes a numeric vector of prices and evaluates to a numeric vector of returns.

```
> library("PMwR")
> returns(100:105)
```

```
[1] 0.01000 0.00990 0.00980 0.00971 0.00962
```

The function will recognise when the input argument has several columns, i.e. is a matrix or a data frame. In such a case, it computes returns for each column.

In fact, returns is a generic function, and also understands time-series such as zoo objects. To demonstrate this functionality, we use the datasets DAX and REXP, which are provided by PMwR. Both are data frames of one column; the rownames are the dates.

```
> library("zoo")
> DAX <- zoo(DAX[[1]], as.Date(row.names(DAX)))
> REXP <- zoo(REXP[[1]], as.Date(row.names(REXP)))
```

Calling returns on a zoo series will result in a zoo series.

```
> str(DAX)
```

```
'zoo' series from 2014-01-02 to 2015-12-30
Data: num [1:505] 9400 9435 9428 9506 9498 ...
Index: Date[1:505], format: "2014-01-02" "2014-01-03" "2014-01-06" "2014-01-07" ...
```

```
> head(returns(DAX))
```

```
2014-01-03 2014-01-06 2014-01-07 2014-01-08 2014-01-09 2014-01-10
 0.003735 -0.000758  0.008294 -0.000879 -0.008026  0.005480
```

Matrices work as well: As an example, we combine both zoo series into a two-column matrix.

```
> returns(head(cbind(DAX, REXP), 5))
```

```
          DAX      REXP
2014-01-03 0.003735 0.000611
2014-01-06 -0.000758 0.001704
2014-01-07 0.008294 0.000621
2014-01-08 -0.000879 -0.000131
```

When a calendar timestamp is available, returns may also aggregate prices over specific holding periods.

```
> returns(DAX, period = "year")
```

```
2014 2015
 4.3  9.6
```

```
> returns(DAX, period = "month")
```

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YTD
2014	-1.0	4.1	-1.4	0.5	3.5	-1.1	-4.3	0.7	0.0	-1.6	7.0	-1.8	4.3
2015	9.1	6.6	5.0	-4.3	-0.4	-4.1	3.3	-9.3	-5.8	12.3	4.9	-5.6	9.6

```
> returns(DAX, period = "2015")
```

```
9.6% [30 Dec 2014 -- 30 Dec 2015]
```

```
> returns(DAX, period = "annualised")
```

```
6.9% [02 Jan 2014 -- 30 Dec 2015]
```

Again, this also works for matrices.

```
> returns(cbind(DAX, REXP), period = "year")
```

	DAX	REXP
2014	4.3	7.1
2015	9.6	0.5

```
> returns(cbind(DAX, REXP), period = "month")
```

	DAX	REXP
2014-01-31	-1.0	1.8
2014-02-28	4.1	0.4
2014-03-31	-1.4	0.1
2014-04-30	0.5	0.3
2014-05-30	3.5	0.9
2014-06-30	-1.1	0.4
2014-07-31	-4.3	0.4
2014-08-29	0.7	1.0
2014-09-30	0.0	-0.1
2014-10-31	-1.6	0.1
2014-11-28	7.0	0.4
2014-12-30	-1.8	1.0
2015-01-30	9.1	0.3
2015-02-27	6.6	0.1
2015-03-31	5.0	0.3
2015-04-30	-4.3	-0.5
2015-05-29	-0.4	-0.2
2015-06-30	-4.1	-0.8
2015-07-31	3.3	0.7
2015-08-31	-9.3	0.0
2015-09-30	-5.8	0.4
2015-10-30	12.3	0.4
2015-11-30	4.9	0.3
2015-12-30	-5.6	-0.6

Despite the way these holding-period returns are printed: the result of the function call is a numeric vector (the return numbers), with additional information added through attributes. It is thus natural to compute with the returns, e.g. to calculate means, extremes or similar quantities.

```
> range(returns(DAX, period = "month"))
```

```
[1] -0.0928 0.1232
```

There are methods for toLatex and toHTML for monthly returns. For instance, the table

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YTD
2014	-1.0	4.1	-1.4	0.5	3.5	-1.1	-4.3	0.7	0.0	-1.6	7.0	-1.8	4.3
2015	9.1	6.6	5.0	-4.3	-0.4	-4.1	3.3	-9.3	-5.8	12.3	4.9	-5.6	9.6

is essentially prepared by the call

```
> toLatex(returns(DAX, period = "month"))
```

See the vignette source for the tabular header. More examples are in the FinTeX vignette; say

```
> vignette("FinTeX", package = "PMWR")
```

to open it.