



Introduction to the R Language

Loop Functions - apply

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apply

`apply` is used to evaluate a function (often an anonymous one) over the margins of an array.

- It is most often used to apply a function to the rows or columns of a matrix
- It can be used with general arrays, e.g. taking the average of an array of matrices
- It is not really faster than writing a loop, but it works in one line!

apply

```
> str(apply)
function (X, MARGIN, FUN, ...)
```

- **X** is an array
- **MARGIN** is an integer vector indicating which margins should be “retained”.
- **FUN** is a function to be applied
- ... is for other arguments to be passed to **FUN**

apply

```
> x <- matrix(rnorm(200), 20, 10)
> apply(x, 2, mean)
[1] 0.04868268 0.35743615 -0.09104379
[4] -0.05381370 -0.16552070 -0.18192493
[7] 0.10285727 0.36519270 0.14898850
[10] 0.26767260

> apply(x, 1, sum)
[1] -1.94843314 2.60601195 1.51772391
[4] -2.80386816 3.73728682 -1.69371360
[7] 0.02359932 3.91874808 -2.39902859
[10] 0.48685925 -1.77576824 -3.34016277
[13] 4.04101009 0.46515429 1.83687755
[16] 4.36744690 2.21993789 2.60983764
[19] -1.48607630 3.58709251
```

col/row sums and means

For sums and means of matrix dimensions, we have some shortcuts.

- `rowSums = apply(x, 1, sum)`
- `rowMeans = apply(x, 1, mean)`
- `colSums = apply(x, 2, sum)`
- `colMeans = apply(x, 2, mean)`

The shortcut functions are *much* faster, but you won't notice unless you're using a large matrix.

Other Ways to Apply

Quantiles of the rows of a matrix.

```
> x <- matrix(rnorm(200), 20, 10)
> apply(x, 1, quantile, probs = c(0.25, 0.75))
```

	[,1]	[,2]	[,3]	[,4]
25%	-0.3304284	-0.99812467	-0.9186279	-0.49711686
75%	0.9258157	0.07065724	0.3050407	-0.06585436
	[,5]	[,6]	[,7]	[,8]
25%	-0.05999553	-0.6588380	-0.653250	0.01749997
75%	0.52928743	0.3727449	1.255089	0.72318419
	[,9]	[,10]	[,11]	[,12]
25%	-1.2467955	-0.8378429	-1.0488430	-0.7054902
75%	0.3352377	0.7297176	0.3113434	0.4581150
	[,13]	[,14]	[,15]	[,16]
25%	-0.1895108	-0.5729407	-0.5968578	-0.9517069
75%	0.5326299	0.5064267	0.4933852	0.8868922
	[,17]	[,18]	[,19]	[,20]

apply

Average matrix in an array

```
> a <- array(rnorm(2 * 2 * 10), c(2, 2, 10))
> apply(a, c(1, 2), mean)
      [,1]      [,2]
[1,] -0.2353245 -0.03980211
[2,] -0.3339748  0.04364908

> rowMeans(a, dims = 2)
      [,1]      [,2]
[1,] -0.2353245 -0.03980211
[2,] -0.3339748  0.04364908
```