The_apply_family.R

015004

Thu Feb 21 13:44:41 2019

```
#################
# Load packages #
#################

#install.packages("JM")
library(JM)
```

```
## Warning: package 'JM' was built under R version 3.5.2
```

```
## Loading required package: MASS
```

```
## Loading required package: nlme
```

```
## Loading required package: splines
```

```
## Loading required package: survival
```

```
## Warning: package 'survival' was built under R version 3.5.2
```

```
####################
# The apply family #
####################

## apply
apply(pbc2.id[, c(2,5)], 2, mean)
```

```
##     years       age
##  6.411239 50.020376
```

```
apply(pbc2.id[, c("years", "age")], 2, mean)
```

```
##     years       age
##  6.411239 50.020376
```

```
X <-  sample(0:200, 100)
Mat <- matrix(X, 50, 50)
apply(Mat, 1, mean)
```

```
##  [1]  34.5  76.5 160.0 134.0 101.5 107.0 154.0 149.0  68.5  95.5 114.5
## [12] 126.0 169.0 151.5  73.0 136.5 174.5 127.5  28.5 175.5 168.0  94.0
## [23]  73.5 153.5 109.5 128.0  36.0  83.0 151.0 195.5  98.5  85.5  86.5
## [34]  94.0  38.5  76.5 119.0  83.0  50.5 136.5 152.5  12.5 101.0 144.0
## [45]  94.0   8.5  90.5  93.0  25.5  45.5
```

```
apply(Mat, 2, mean)
```

```
##  [1] 110.48  96.90 110.48  96.90 110.48  96.90 110.48  96.90 110.48  96.90
## [11] 110.48  96.90 110.48  96.90 110.48  96.90 110.48  96.90 110.48  96.90
## [21] 110.48  96.90 110.48  96.90 110.48  96.90 110.48  96.90 110.48  96.90
## [31] 110.48  96.90 110.48  96.90 110.48  96.90 110.48  96.90 110.48  96.90
## [41] 110.48  96.90 110.48  96.90 110.48  96.90 110.48  96.90 110.48  96.90
```

```r
apply(Mat, 2, function(x) x^2)
```

```
##        [,1]  [,2]  [,3]  [,4]  [,5]  [,6]  [,7]  [,8]  [,9] [,10] [,11]
##  [1,]  3600    81  3600    81  3600    81  3600    81  3600    81  3600
##  [2,] 20449   100 20449   100 20449   100 20449   100 20449   100 20449
##  [3,] 23409 27889 23409 27889 23409 27889 23409 27889 23409 27889 23409
##  [4,]  7225 33489  7225 33489  7225 33489  7225 33489  7225 33489  7225
##  [5,] 18769  4356 18769  4356 18769  4356 18769  4356 18769  4356 18769
##  [6,] 26896  2500 26896  2500 26896  2500 26896  2500 26896  2500 26896
##  [7,] 24649 22801 24649 22801 24649 22801 24649 22801 24649 22801 24649
##  [8,] 14161 32041 14161 32041 14161 32041 14161 32041 14161 32041 14161
##  [9,] 14641   256 14641   256 14641   256 14641   256 14641   256 14641
## [10,] 17956  3249 17956  3249 17956  3249 17956  3249 17956  3249 17956
## [11,] 13689 12544 13689 12544 13689 12544 13689 12544 13689 12544 13689
## [12,]  6084 30276  6084 30276  6084 30276  6084 30276  6084 30276  6084
## [13,] 39204 19600 39204 19600 39204 19600 39204 19600 39204 19600 39204
## [14,] 28900 17689 28900 17689 28900 17689 28900 17689 28900 17689 28900
## [15,]  8649  2809  8649  2809  8649  2809  8649  2809  8649  2809  8649
## [16,] 21316 16129 21316 16129 21316 16129 21316 16129 21316 16129 21316
## [17,] 32400 28561 32400 28561 32400 28561 32400 28561 32400 28561 32400
## [18,]  4225 36100  4225 36100  4225 36100  4225 36100  4225 36100  4225
## [19,]     4  3025     4  3025     4  3025     4  3025     4  3025     4
## [20,] 34596 27225 34596 27225 34596 27225 34596 27225 34596 27225 34596
## [21,] 22201 34969 22201 34969 22201 34969 22201 34969 22201 34969 22201
## [22,] 12769  5625 12769  5625 12769  5625 12769  5625 12769  5625 12769
## [23,] 10201  2116 10201  2116 10201  2116 10201  2116 10201  2116 10201
## [24,] 31329 16900 31329 16900 31329 16900 31329 16900 31329 16900 31329
## [25,] 18496  6889 18496  6889 18496  6889 18496  6889 18496  6889 18496
## [26,] 11881 21609 11881 21609 11881 21609 11881 21609 11881 21609 11881
## [27,]   576  2304   576  2304   576  2304   576  2304   576  2304   576
## [28,] 19044   784 19044   784 19044   784 19044   784 19044   784 19044
## [29,] 22500 23104 22500 23104 22500 23104 22500 23104 22500 23104 22500
## [30,] 37636 38809 37636 38809 37636 38809 37636 38809 37636 38809 37636
## [31,]  9801  9604  9801  9604  9801  9604  9801  9604  9801  9604  9801
## [32,]   676 21025   676 21025   676 21025   676 21025   676 21025   676
## [33,]  1936 16641  1936 16641  1936 16641  1936 16641  1936 16641  1936
## [34,]   289 29241   289 29241   289 29241   289 29241   289 29241   289
## [35,]    36  5041    36  5041    36  5041    36  5041    36  5041    36
## [36,]  5476  6241  5476  6241  5476  6241  5476  6241  5476  6241  5476
## [37,] 27556  5184 27556  5184 27556  5184 27556  5184 27556  5184 27556
## [38,] 23716   144 23716   144 23716   144 23716   144 23716   144 23716
## [39,]  3844  1521  3844  1521  3844  1521  3844  1521  3844  1521  3844
## [40,] 32761  8464 32761  8464 32761  8464 32761  8464 32761  8464 32761
## [41,] 26569 20164 26569 20164 26569 20164 26569 20164 26569 20164 26569
## [42,]     0   625     0   625     0   625     0   625     0   625     0
## [43,] 14400  6724 14400  6724 14400  6724 14400  6724 14400  6724 14400
## [44,] 13456 29584 13456 29584 13456 29584 13456 29584 13456 29584 13456
## [45,] 24964   900 24964   900 24964   900 24964   900 24964   900 24964
## [46,]     9   196     9   196     9   196     9   196     9   196     9
## [47,] 17424  2401 17424  2401 17424  2401 17424  2401 17424  2401 17424
## [48,] 28224   324 28224   324 28224   324 28224   324 28224   324 28224
## [49,]   225  1296   225  1296   225  1296   225  1296   225  1296   225
## [50,]   441  4900   441  4900   441  4900   441  4900   441  4900   441
##       [,12] [,13] [,14] [,15] [,16] [,17] [,18] [,19] [,20] [,21] [,22]
##  [1,]    81  3600    81  3600    81  3600    81  3600    81  3600    81
##  [2,]   100 20449   100 20449   100 20449   100 20449   100 20449   100
##  [3,] 27889 23409 27889 23409 27889 23409 27889 23409 27889 23409 27889
##  [4,] 33489  7225 33489  7225 33489  7225 33489  7225 33489  7225 33489
##  [5,]  4356 18769  4356 18769  4356 18769  4356 18769  4356 18769  4356
##  [6,]  2500 26896  2500 26896  2500 26896  2500 26896  2500 26896  2500
##  [7,] 22801 24649 22801 24649 22801 24649 22801 24649 22801 24649 22801
##  [8,] 32041 14161 32041 14161 32041 14161 32041 14161 32041 14161 32041
##  [9,]   256 14641   256 14641   256 14641   256 14641   256 14641   256
## [10,]  3249 17956  3249 17956  3249 17956  3249 17956  3249 17956  3249
## [11,] 12544 13689 12544 13689 12544 13689 12544 13689 12544 13689 12544
## [12,] 30276  6084 30276  6084 30276  6084 30276  6084 30276  6084 30276
## [13,] 19600 39204 19600 39204 19600 39204 19600 39204 19600 39204 19600
## [14,] 17689 28900 17689 28900 17689 28900 17689 28900 17689 28900 17689
## [15,]  2809  8649  2809  8649  2809  8649  2809  8649  2809  8649  2809
## [16,] 16129 21316 16129 21316 16129 21316 16129 21316 16129 21316 16129
## [17,] 28561 32400 28561 32400 28561 32400 28561 32400 28561 32400 28561
## [18,] 36100  4225 36100  4225 36100  4225 36100  4225 36100  4225 36100
## [19,]  3025     4  3025     4  3025     4  3025     4  3025     4  3025
## [20,] 27225 34596 27225 34596 27225 34596 27225 34596 27225 34596 27225
## [21,] 34969 22201 34969 22201 34969 22201 34969 22201 34969 22201 34969
## [22,]  5625 12769  5625 12769  5625 12769  5625 12769  5625 12769  5625
## [23,]  2116 10201  2116 10201  2116 10201  2116 10201  2116 10201  2116
## [24,] 16900 31329 16900 31329 16900 31329 16900 31329 16900 31329 16900
## [25,]  6889 18496  6889 18496  6889 18496  6889 18496  6889 18496  6889
## [26,] 21609 11881 21609 11881 21609 11881 21609 11881 21609 11881 21609
## [27,]  2304   576  2304   576  2304   576  2304   576  2304   576  2304
## [28,]   784 19044   784 19044   784 19044   784 19044   784 19044   784
## [29,] 23104 22500 23104 22500 23104 22500 23104 22500 23104 22500 23104
## [30,] 38809 37636 38809 37636 38809 37636 38809 37636 38809 37636 38809
## [31,]  9604  9801  9604  9801  9604  9801  9604  9801  9604  9801  9604
## [32,] 21025   676 21025   676 21025   676 21025   676 21025   676 21025
## [33,] 16641  1936 16641  1936 16641  1936 16641  1936 16641  1936 16641
## [34,] 29241   289 29241   289 29241   289 29241   289 29241   289 29241
## [35,]  5041    36  5041    36  5041    36  5041    36  5041    36  5041
## [36,]  6241  5476  6241  5476  6241  5476  6241  5476  6241  5476  6241
## [37,]  5184 27556  5184 27556  5184 27556  5184 27556  5184 27556  5184
## [38,]   144 23716   144 23716   144 23716   144 23716   144 23716   144
## [39,]  1521  3844  1521  3844  1521  3844  1521  3844  1521  3844  1521
## [40,]  8464 32761  8464 32761  8464 32761  8464 32761  8464 32761  8464
## [41,] 20164 26569 20164 26569 20164 26569 20164 26569 20164 26569 20164
## [42,]   625     0   625     0   625     0   625     0   625     0   625
## [43,]  6724 14400  6724 14400  6724 14400  6724 14400  6724 14400  6724
## [44,] 29584 13456 29584 13456 29584 13456 29584 13456 29584 13456 29584
## [45,]   900 24964   900 24964   900 24964   900 24964   900 24964   900
## [46,]   196     9   196     9   196     9   196     9   196     9   196
## [47,]  2401 17424  2401 17424  2401 17424  2401 17424  2401 17424  2401
## [48,]   324 28224   324 28224   324 28224   324 28224   324 28224   324
## [49,]  1296   225  1296   225  1296   225  1296   225  1296   225  1296
## [50,]  4900   441  4900   441  4900   441  4900   441  4900   441  4900
##       [,23] [,24] [,25] [,26] [,27] [,28] [,29] [,30] [,31] [,32] [,33]
##  [1,]  3600    81  3600    81  3600    81  3600    81  3600    81  3600
##  [2,] 20449   100 20449   100 20449   100 20449   100 20449   100 20449
##  [3,] 23409 27889 23409 27889 23409 27889 23409 27889 23409 27889 23409
##  [4,]  7225 33489  7225 33489  7225 33489  7225 33489  7225 33489  7225
##  [5,] 18769  4356 18769  4356 18769  4356 18769  4356 18769  4356 18769
##  [6,] 26896  2500 26896  2500 26896  2500 26896  2500 26896  2500 26896
##  [7,] 24649 22801 24649 22801 24649 22801 24649 22801 24649 22801 24649
##  [8,] 14161 32041 14161 32041 14161 32041 14161 32041 14161 32041 14161
##  [9,] 14641   256 14641   256 14641   256 14641   256 14641   256 14641
## [10,] 17956  3249 17956  3249 17956  3249 17956  3249 17956  3249 17956
## [11,] 13689 12544 13689 12544 13689 12544 13689 12544 13689 12544 13689
## [12,]  6084 30276  6084 30276  6084 30276  6084 30276  6084 30276  6084
## [13,] 39204 19600 39204 19600 39204 19600 39204 19600 39204 19600 39204
## [14,] 28900 17689 28900 17689 28900 17689 28900 17689 28900 17689 28900
## [15,]  8649  2809  8649  2809  8649  2809  8649  2809  8649  2809  8649
## [16,] 21316 16129 21316 16129 21316 16129 21316 16129 21316 16129 21316
## [17,] 32400 28561 32400 28561 32400 28561 32400 28561 32400 28561 32400
## [18,]  4225 36100  4225 36100  4225 36100  4225 36100  4225 36100  4225
## [19,]     4  3025     4  3025     4  3025     4  3025     4  3025     4
## [20,] 34596 27225 34596 27225 34596 27225 34596 27225 34596 27225 34596
## [21,] 22201 34969 22201 34969 22201 34969 22201 34969 22201 34969 22201
## [22,] 12769  5625 12769  5625 12769  5625 12769  5625 12769  5625 12769
## [23,] 10201  2116 10201  2116 10201  2116 10201  2116 10201  2116 10201
## [24,] 31329 16900 31329 16900 31329 16900 31329 16900 31329 16900 31329
## [25,] 18496  6889 18496  6889 18496  6889 18496  6889 18496  6889 18496
## [26,] 11881 21609 11881 21609 11881 21609 11881 21609 11881 21609 11881
## [27,]   576  2304   576  2304   576  2304   576  2304   576  2304   576
## [28,] 19044   784 19044   784 19044   784 19044   784 19044   784 19044
## [29,] 22500 23104 22500 23104 22500 23104 22500 23104 22500 23104 22500
## [30,] 37636 38809 37636 38809 37636 38809 37636 38809 37636 38809 37636
## [31,]  9801  9604  9801  9604  9801  9604  9801  9604  9801  9604  9801
## [32,]   676 21025   676 21025   676 21025   676 21025   676 21025   676
## [33,]  1936 16641  1936 16641  1936 16641  1936 16641  1936 16641  1936
## [34,]   289 29241   289 29241   289 29241   289 29241   289 29241   289
## [35,]    36  5041    36  5041    36  5041    36  5041    36  5041    36
## [36,]  5476  6241  5476  6241  5476  6241  5476  6241  5476  6241  5476
## [37,] 27556  5184 27556  5184 27556  5184 27556  5184 27556  5184 27556
## [38,] 23716   144 23716   144 23716   144 23716   144 23716   144 23716
## [39,]  3844  1521  3844  1521  3844  1521  3844  1521  3844  1521  3844
## [40,] 32761  8464 32761  8464 32761  8464 32761  8464 32761  8464 32761
## [41,] 26569 20164 26569 20164 26569 20164 26569 20164 26569 20164 26569
## [42,]     0   625     0   625     0   625     0   625     0   625     0
## [43,] 14400  6724 14400  6724 14400  6724 14400  6724 14400  6724 14400
## [44,] 13456 29584 13456 29584 13456 29584 13456 29584 13456 29584 13456
## [45,] 24964   900 24964   900 24964   900 24964   900 24964   900 24964
## [46,]     9   196     9   196     9   196     9   196     9   196     9
## [47,] 17424  2401 17424  2401 17424  2401 17424  2401 17424  2401 17424
## [48,] 28224   324 28224   324 28224   324 28224   324 28224   324 28224
## [49,]   225  1296   225  1296   225  1296   225  1296   225  1296   225
## [50,]   441  4900   441  4900   441  4900   441  4900   441  4900   441
##       [,34] [,35] [,36] [,37] [,38] [,39] [,40] [,41] [,42] [,43] [,44]
##  [1,]    81  3600    81  3600    81  3600    81  3600    81  3600    81
##  [2,]   100 20449   100 20449   100 20449   100 20449   100 20449   100
##  [3,] 27889 23409 27889 23409 27889 23409 27889 23409 27889 23409 27889
##  [4,] 33489  7225 33489  7225 33489  7225 33489  7225 33489  7225 33489
##  [5,]  4356 18769  4356 18769  4356 18769  4356 18769  4356 18769  4356
##  [6,]  2500 26896  2500 26896  2500 26896  2500 26896  2500 26896  2500
##  [7,] 22801 24649 22801 24649 22801 24649 22801 24649 22801 24649 22801
##  [8,] 32041 14161 32041 14161 32041 14161 32041 14161 32041 14161 32041
##  [9,]   256 14641   256 14641   256 14641   256 14641   256 14641   256
## [10,]  3249 17956  3249 17956  3249 17956  3249 17956  3249 17956  3249
## [11,] 12544 13689 12544 13689 12544 13689 12544 13689 12544 13689 12544
## [12,] 30276  6084 30276  6084 30276  6084 30276  6084 30276  6084 30276
## [13,] 19600 39204 19600 39204 19600 39204 19600 39204 19600 39204 19600
## [14,] 17689 28900 17689 28900 17689 28900 17689 28900 17689 28900 17689
## [15,]  2809  8649  2809  8649  2809  8649  2809  8649  2809  8649  2809
## [16,] 16129 21316 16129 21316 16129 21316 16129 21316 16129 21316 16129
## [17,] 28561 32400 28561 32400 28561 32400 28561 32400 28561 32400 28561
## [18,] 36100  4225 36100  4225 36100  4225 36100  4225 36100  4225 36100
## [19,]  3025     4  3025     4  3025     4  3025     4  3025     4  3025
## [20,] 27225 34596 27225 34596 27225 34596 27225 34596 27225 34596 27225
## [21,] 34969 22201 34969 22201 34969 22201 34969 22201 34969 22201 34969
## [22,]  5625 12769  5625 12769  5625 12769  5625 12769  5625 12769  5625
## [23,]  2116 10201  2116 10201  2116 10201  2116 10201  2116 10201  2116
## [24,] 16900 31329 16900 31329 16900 31329 16900 31329 16900 31329 16900
## [25,]  6889 18496  6889 18496  6889 18496  6889 18496  6889 18496  6889
## [26,] 21609 11881 21609 11881 21609 11881 21609 11881 21609 11881 21609
## [27,]  2304   576  2304   576  2304   576  2304   576  2304   576  2304
## [28,]   784 19044   784 19044   784 19044   784 19044   784 19044   784
## [29,] 23104 22500 23104 22500 23104 22500 23104 22500 23104 22500 23104
## [30,] 38809 37636 38809 37636 38809 37636 38809 37636 38809 37636 38809
## [31,]  9604  9801  9604  9801  9604  9801  9604  9801  9604  9801  9604
## [32,] 21025   676 21025   676 21025   676 21025   676 21025   676 21025
## [33,] 16641  1936 16641  1936 16641  1936 16641  1936 16641  1936 16641
## [34,] 29241   289 29241   289 29241   289 29241   289 29241   289 29241
## [35,]  5041    36  5041    36  5041    36  5041    36  5041    36  5041
## [36,]  6241  5476  6241  5476  6241  5476  6241  5476  6241  5476  6241
## [37,]  5184 27556  5184 27556  5184 27556  5184 27556  5184 27556  5184
## [38,]   144 23716   144 23716   144 23716   144 23716   144 23716   144
## [39,]  1521  3844  1521  3844  1521  3844  1521  3844  1521  3844  1521
## [40,]  8464 32761  8464 32761  8464 32761  8464 32761  8464 32761  8464
## [41,] 20164 26569 20164 26569 20164 26569 20164 26569 20164 26569 20164
## [42,]   625     0   625     0   625     0   625     0   625     0   625
## [43,]  6724 14400  6724 14400  6724 14400  6724 14400  6724 14400  6724
## [44,] 29584 13456 29584 13456 29584 13456 29584 13456 29584 13456 29584
## [45,]   900 24964   900 24964   900 24964   900 24964   900 24964   900
## [46,]   196     9   196     9   196     9   196     9   196     9   196
## [47,]  2401 17424  2401 17424  2401 17424  2401 17424  2401 17424  2401
## [48,]   324 28224   324 28224   324 28224   324 28224   324 28224   324
## [49,]  1296   225  1296   225  1296   225  1296   225  1296   225  1296
## [50,]  4900   441  4900   441  4900   441  4900   441  4900   441  4900
##       [,45] [,46] [,47] [,48] [,49] [,50]
##  [1,]  3600    81  3600    81  3600    81
##  [2,] 20449   100 20449   100 20449   100
##  [3,] 23409 27889 23409 27889 23409 27889
##  [4,]  7225 33489  7225 33489  7225 33489
##  [5,] 18769  4356 18769  4356 18769  4356
##  [6,] 26896  2500 26896  2500 26896  2500
##  [7,] 24649 22801 24649 22801 24649 22801
##  [8,] 14161 32041 14161 32041 14161 32041
##  [9,] 14641   256 14641   256 14641   256
## [10,] 17956  3249 17956  3249 17956  3249
## [11,] 13689 12544 13689 12544 13689 12544
## [12,]  6084 30276  6084 30276  6084 30276
## [13,] 39204 19600 39204 19600 39204 19600
## [14,] 28900 17689 28900 17689 28900 17689
## [15,]  8649  2809  8649  2809  8649  2809
## [16,] 21316 16129 21316 16129 21316 16129
## [17,] 32400 28561 32400 28561 32400 28561
## [18,]  4225 36100  4225 36100  4225 36100
## [19,]     4  3025     4  3025     4  3025
## [20,] 34596 27225 34596 27225 34596 27225
## [21,] 22201 34969 22201 34969 22201 34969
## [22,] 12769  5625 12769  5625 12769  5625
## [23,] 10201  2116 10201  2116 10201  2116
## [24,] 31329 16900 31329 16900 31329 16900
## [25,] 18496  6889 18496  6889 18496  6889
## [26,] 11881 21609 11881 21609 11881 21609
## [27,]   576  2304   576  2304   576  2304
## [28,] 19044   784 19044   784 19044   784
## [29,] 22500 23104 22500 23104 22500 23104
## [30,] 37636 38809 37636 38809 37636 38809
## [31,]  9801  9604  9801  9604  9801  9604
## [32,]   676 21025   676 21025   676 21025
## [33,]  1936 16641  1936 16641  1936 16641
## [34,]   289 29241   289 29241   289 29241
## [35,]    36  5041    36  5041    36  5041
## [36,]  5476  6241  5476  6241  5476  6241
## [37,] 27556  5184 27556  5184 27556  5184
## [38,] 23716   144 23716   144 23716   144
## [39,]  3844  1521  3844  1521  3844  1521
## [40,] 32761  8464 32761  8464 32761  8464
## [41,] 26569 20164 26569 20164 26569 20164
## [42,]     0   625     0   625     0   625
## [43,] 14400  6724 14400  6724 14400  6724
## [44,] 13456 29584 13456 29584 13456 29584
## [45,] 24964   900 24964   900 24964   900
## [46,]     9   196     9   196     9   196
## [47,] 17424  2401 17424  2401 17424  2401
## [48,] 28224   324 28224   324 28224   324
## [49,]   225  1296   225  1296   225  1296
## [50,]   441  4900   441  4900   441  4900
```

```r
## lapply

lapply(1:3, function(x) x^2)
```

```
## [[1]]
## [1] 1
##
## [[2]]
## [1] 4
##
## [[3]]
## [1] 9
```

```r
X <- list(Mat, Mat^2)
lapply(X, mean)
```

```
## [[1]]
## [1] 103.69
##
## [[2]]
## [1] 14233.07
```

```r
A <- matrix(1:9, 3,3)
B <- matrix(4:15, 4,3)
C <- matrix(8:10, 3,2)
MyList <- list(A,B,C)
lapply(MyList,"[", 1, )
```

```
## [[1]]
## [1] 1 4 7
##
## [[2]]
## [1]  4  8 12
##
## [[3]]
## [1] 8 8
```

```r
lapply(MyList,"[", , 2)
```

```
## [[1]]
## [1] 4 5 6
##
## [[2]]
## [1]  8  9 10 11
##
## [[3]]
## [1]  8  9 10
```

```r
## sapply

sapply(1:3, function(x) x^2)
```

```
## [1] 1 4 9
```

```r
X <- list(Mat, Mat^2)
sapply(X, mean)
```

```
## [1]   103.69 14233.07
```

```r
sapply(MyList,"[", 2, 1)
```

```
## [1] 2 5 9
```

```r
## tapply

tapply(pbc2.id$age, pbc2.id$sex, mean)
```

```
##     male   female
## 56.20346 49.21389
```

```r
tapply(pbc2.id$years, pbc2.id$sex, mean)
```

```
##     male   female
## 5.796721 6.491394
```

```r
tapply(pbc2.id$age, pbc2.id$sex, function(x) mean(x/2))
```

```
##     male   female
## 28.10173 24.60694
```

```r
## mapply

mapply(rep, 1:4, 4:1)
```

```
## [[1]]
## [1] 1 1 1 1
##
## [[2]]
## [1] 2 2 2
##
## [[3]]
## [1] 3 3
##
## [[4]]
## [1] 4
```

```r
#### list(rep(1, 4), rep(2, 3), rep(3, 2), rep(4, 1))

mapply(rep, times = 1:4, x = 4)
```

```
## [[1]]
## [1] 4
##
## [[2]]
## [1] 4 4
##
## [[3]]
## [1] 4 4 4
##
## [[4]]
## [1] 4 4 4 4
```

```r
#### list(rep(4, times = 1), rep(4, times = 2), rep(4, times = 3), rep(4, times = 4))

X = matrix(c(rep(1, 4), rep(2, 4), rep(3, 4), rep(4, 4)), 4, 4)
mapply(rep, 1:4, 4)
```

```
##      [,1] [,2] [,3] [,4]
## [1,]    1    2    3    4
## [2,]    1    2    3    4
## [3,]    1    2    3    4
## [4,]    1    2    3    4
```

```r
mapply(function(x,y) seq_len(x) + y,
       c(a = 1, b = 2, c = 3),
       c(A = 10, B = 0, C = -10))
```

```
## $a
## [1] 11
##
```

```
## $b
## [1] 1 2
##
## $c
## [1] -9 -8 -7
```

```
#### list(c(1) + 10, c(1, 2) + 0, c(1, 2, 3) - 10)

X <- list(Mat, Mat^2)
mapply(mean, X)
```

```
## [1]   103.69 14233.07
```

```
mapply(mean, MyList)
```

```
## [1] 5.0 9.5 9.0
```

```
sapply(MyList, mean)
```

```
## [1] 5.0 9.5 9.0
```

```
mapply(function(x,y) {x^y}, x = c(2, 3), y = c(4))
```

```
## [1] 16 81
```

```
#### list(2^4, 3^4)



####################
# Long format data #
####################

## Let's assume that only the long format of the data set is available.
## We want to obtain the mean serum bilirubin of the last follow-up
## measurements per event group.
## Each patient is counted once!
head(pbc2)
```

```
##   id    years status      drug      age    sex      year ascites
## 1  1  1.09517   dead D-penicil 58.76684 female 0.0000000     Yes
## 2  1  1.09517   dead D-penicil 58.76684 female 0.5256817     Yes
## 3  2 14.15234  alive D-penicil 56.44782 female 0.0000000      No
## 4  2 14.15234  alive D-penicil 56.44782 female 0.4983025      No
## 5  2 14.15234  alive D-penicil 56.44782 female 0.9993429      No
## 6  2 14.15234  alive D-penicil 56.44782 female 2.1027270      No
##   hepatomegaly spiders                   edema serBilir serChol albumin
## 1          Yes     Yes edema despite diuretics     14.5     261    2.60
## 2          Yes     Yes edema despite diuretics     21.3      NA    2.94
## 3          Yes     Yes                No edema      1.1     302    4.14
## 4          Yes     Yes                No edema      0.8      NA    3.60
## 5          Yes     Yes                No edema      1.0      NA    3.55
## 6          Yes     Yes                No edema      1.9      NA    3.92
##   alkaline  SGOT platelets prothrombin histologic status2
## 1     1718 138.0       190        12.2          4       1
## 2     1612   6.2       183        11.2          4       1
## 3     7395 113.5       221        10.6          3       0
## 4     2107 139.5       188        11.0          3       0
## 5     1711 144.2       161        11.6          3       0
## 6     1365 144.2       122        10.6          3       0
```

```
## sort data
pbc2 <- pbc2[order(pbc2$id, pbc2$year), ]

## select the last follow-up measurement of each patient
pbc2.idNEW2 <- pbc2[!duplicated(pbc2[c("id")], fromLast = T), ]

## obtain the mean serum bilirubin per event group
tapply(pbc2.idNEW2$serBilir, pbc2.idNEW2$status, mean)
```

```
##        alive transplanted         dead
##     2.190909     9.172414    11.800000
```

```
## Let's assume that we want to obtain the mean serum bilirubin
## of the last stage of edema per event group.
## Each patient and edema stage is counted once!

## sort data
pbc2 <- pbc2[order(pbc2$id, pbc2$edema), ]

## select the last stage of edema of each patient
pbc2.idNEW3 <- pbc2[!duplicated(pbc2[c("id")], fromLast = T), ]

## obtain the mean serum bilirubin per event group
tapply(pbc2.idNEW3$serBilir, pbc2.idNEW3$status, mean)
```

```
##        alive transplanted         dead
##     2.182517     8.651724    11.425000
```