16. Multiple imputation

MICE - Multivariate Imputation through Chained Equation

```
library(mice)
```

```
Warning: package 'mice' was built under R version 4.0.3
```

```
Attaching package: 'mice'
```

```
The following object is masked from 'package:stats':

    filter
```

```
The following objects are masked from 'package:base':

    cbind, rbind
```

```
library(VIM)
```

```
Loading required package: colorspace
```

```
Warning: package 'colorspace' was built under R version 4.0.3
```

```
Loading required package: grid
```

```
VIM is ready to use.
```

```
Suggestions and bug-reports can be submitted at: https://github.com/statistikat/VIM/issues
```

```
Attaching package: 'VIM'
```

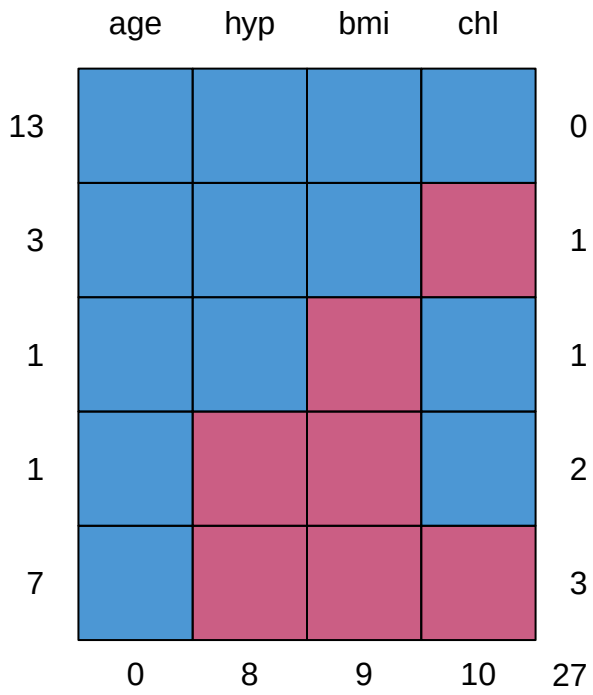
```
The following object is masked from 'package:datasets':

    sleep
```

```
head(nhanes)
```

```
  age  bmi hyp chl
1   1   NA  NA  NA
2   2 22.7   1 187
3   1   NA   1 187
4   3   NA  NA  NA
5   1 20.4   1 113
6   3   NA  NA 184
```

```
md.pattern(nhanes)
```




```
   age hyp bmi chl
13   1   1   1   1  0
3    1   1   1   0  1
1    1   1   0   1  1
1    1   0   0   1  2
7    1   0   0   0  3
     0   8   9  10 27
```

```
mice.pairs=md.pairs(nhanes)
mice.pairs
```

```
$rr
    age bmi hyp chl
age  25  16  17  15
```

```
bmi  16  16  16  13
hyp  17  16  17  14
chl  15  13  14  15

$rm
    age bmi hyp chl
age   0   9   8  10
bmi   0   0   0   3
hyp   0   1   0   3
chl   0   2   1   0

$mr
    age bmi hyp chl
age   0   0   0   0
bmi   9   0   1   2
hyp   8   0   0   1
chl  10   3   3   0

$mm
    age bmi hyp chl
age   0   0   0   0
bmi   0   9   8   7
hyp   0   8   8   7
chl   0   7   7  10
```

```
imputed.data=mice(nhanes,m=5,maxit=5)
```

```
 iter imp variable
  1   1  bmi  hyp  chl
  1   2  bmi  hyp  chl
  1   3  bmi  hyp  chl
  1   4  bmi  hyp  chl
  1   5  bmi  hyp  chl
  2   1  bmi  hyp  chl
  2   2  bmi  hyp  chl
  2   3  bmi  hyp  chl
  2   4  bmi  hyp  chl
  2   5  bmi  hyp  chl
  3   1  bmi  hyp  chl
  3   2  bmi  hyp  chl
  3   3  bmi  hyp  chl
  3   4  bmi  hyp  chl
  3   5  bmi  hyp  chl
  4   1  bmi  hyp  chl
  4   2  bmi  hyp  chl
  4   3  bmi  hyp  chl
  4   4  bmi  hyp  chl
  4   5  bmi  hyp  chl
  5   1  bmi  hyp  chl
  5   2  bmi  hyp  chl
  5   3  bmi  hyp  chl
  5   4  bmi  hyp  chl
  5   5  bmi  hyp  chl
```

```
imputed.data
```

```
Class: mids
Number of multiple imputations:  5
Imputation methods:
  age   bmi   hyp   chl
   "" "pmm" "pmm" "pmm"
PredictorMatrix:
    age bmi hyp chl
age   0   1   1   1
bmi   1   0   1   1
hyp   1   1   0   1
chl   1   1   1   0
```

```
summary(imputed.data)
```

```
Class: mids
Number of multiple imputations:  5
Imputation methods:
  age   bmi   hyp   chl
   "" "pmm" "pmm" "pmm"
PredictorMatrix:
    age bmi hyp chl
age   0   1   1   1
bmi   1   0   1   1
hyp   1   1   0   1
chl   1   1   1   0
```

Check imputed values

```
imputed.data$imp$bmi
```

```
      1    2    3    4    5
1  22.7 29.6 27.2 29.6 33.2
3  28.7 28.7 26.3 29.6 33.2
4  22.5 25.5 25.5 27.2 22.5
6  22.5 20.4 26.3 21.7 24.9
10 22.5 27.5 26.3 27.4 22.0
11 27.2 27.2 22.0 35.3 27.5
12 27.5 20.4 26.3 22.0 27.4
16 33.2 35.3 29.6 22.5 33.2
21 26.3 33.2 29.6 28.7 26.3
```

```
imputed.data$imp$hyp
```

```
   1 2 3 4 5
1  1 1 1 1 1
4  1 2 1 2 2
6  1 1 2 2 2
```

```
10 1 1 1 1 1
11 1 1 1 1 1
12 2 1 2 1 1
16 1 1 1 1 1
21 1 1 1 1 1
```

```
imputed.data$imp$chl
```

```
     1   2   3   4   5
1  238 187 118 131 186
4  199 184 218 204 204
10 187 229 218 218 187
11 187 187 113 187 187
12 206 118 187 184 206
15 187 187 199 187 199
16 184 229 187 187 187
20 284 184 186 284 186
21 118 229 187 187 187
24 218 218 206 204 206
```

Get complete data

```
complete.all=complete(imputed.data)
complete.all
```

```
   age  bmi hyp chl
1    1 22.7   1 238
2    2 22.7   1 187
3    1 28.7   1 187
4    3 22.5   1 199
5    1 20.4   1 113
6    3 22.5   1 184
7    1 22.5   1 118
8    1 30.1   1 187
9    2 22.0   1 238
10   2 22.5   1 187
11   1 27.2   1 187
12   2 27.5   2 206
13   3 21.7   1 206
14   2 28.7   2 204
15   1 29.6   1 187
16   1 33.2   1 184
17   3 27.2   2 284
18   2 26.3   2 199
19   1 35.3   1 218
20   3 25.5   2 284
21   1 26.3   1 118
22   1 33.2   1 229
23   1 27.5   1 131
24   3 24.9   1 218
25   2 27.4   1 186
```

```
head(complete(imputed.data))
```

```
  age  bmi hyp chl
1   1 22.7   1 238
2   2 22.7   1 187
3   1 28.7   1 187
4   3 22.5   1 199
5   1 20.4   1 113
6   3 22.5   1 184
```

```
complete.2=complete(imputed.data,2)
head(complete(imputed.data,2))
```

```
  age  bmi hyp chl
1   1 29.6   1 187
2   2 22.7   1 187
3   1 28.7   1 187
4   3 25.5   2 184
5   1 20.4   1 113
6   3 20.4   1 184
```

```
#save file on disk
write.csv(x=complete.all,file="MICE.csv")
```