Exercise 1

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Checking current R version

```
R.version
```

```
               _
platform       aarch64-apple-darwin20
arch           aarch64
os             darwin20
system         aarch64, darwin20
status
major          4
minor          3.1
year           2023
month          06
day            16
svn rev        84548
language       R
version.string R version 4.3.1 (2023-06-16)
nickname       Beagle Scouts
```

- How to install packages? (DMwR2 needed for Data Mining)

```
if(!require("DMwR2"))
install.packages("DMwR2")
```

- Getting official documentation for any package

```
help(package="DMwR2")
```

- 1. Loading the library

2. when you only need to use the function one or twice, you can call the `function/dataset` through the notation `package::functionname`

```
library(DMwR2)
```

Now you can use any function or dataset provided in `DMwR2` by referencing its name directly.

```
data(algae)
algae
```

```
# A tibble: 200 x 18
   season size  speed   mxPH  mnO2    Cl    NO3   NH4  oPO4   PO4  Chla    a1
   <fct>  <fct> <fct>  <dbl> <dbl> <dbl>  <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
 1 winter small medium  8      9.8  60.8  6.24  578   105   170   50      0
 2 spring small medium  8.35   8    57.8  1.29  370   429.  559.   1.3    1.4
 3 autumn small medium  8.1   11.4  40.0  5.33  347.  126.  187.  15.6    3.3
 4 spring small medium  8.07   4.8  77.4  2.30   98.2  61.2 139.   1.4    3.1
 5 autumn small medium  8.06   9    55.4 10.4   234.   58.2  97.6 10.5    9.2
 6 winter small high    8.25  13.1  65.8  9.25  430    18.2  56.7 28.4   15.1
 7 summer small high    8.15  10.3  73.2  1.54  110    61.2 112.   3.2    2.4
 8 autumn small high    8.05  10.6  59.1  4.99  206.   44.7  77.4  6.9   18.2
 9 winter small medium  8.7    3.4  22.0  0.886 103.   36.3  71    5.54  25.4
10 winter small high    7.93   9.9   8    1.39    5.8  27.2  46.6  0.8   17
# i 190 more rows
# i 6 more variables: a2 <dbl>, a3 <dbl>, a4 <dbl>, a5 <dbl>, a6 <dbl>,
#   a7 <dbl>
```

```
manyNAs(algae)
```

```
[1]  62 199
```

`library()` without arguments:

```
library()
```

Show packages loaded in the current session:

```
#(.packages())
```

```
library(dbplyr)
(.packages())
```

```
[1] "dbplyr"    "DMwR2"     "stats"     "graphics"  "grDevices" "utils"
[7] "datasets"  "methods"   "base"
```

```
#Detaching package that was loaded incorrectly
detach("package:dbplyr", unload=TRUE)
(.packages())
```

```
[1] "DMwR2"     "stats"     "graphics"  "grDevices" "utils"     "datasets"
[7] "methods"   "base"
```

```
library(dplyr)
```

```
Attaching package: 'dplyr'

The following objects are masked from 'package:stats':

    filter, lag

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

    intersect, setdiff, setequal, union
```

Another way to see what packages have been installed in your computer:

```
installed.packages()
```

```
                Package
AsioHeaders     "AsioHeaders"
askpass         "askpass"
backports       "backports"
base            "base"
base64enc       "base64enc"
bit             "bit"
```

```
bit64             "bit64"
blob              "blob"
bookdown          "bookdown"
boot              "boot"
brio              "brio"
broom             "broom"
bslib             "bslib"
cachem            "cachem"
callr             "callr"
checkmate         "checkmate"
class             "class"
cli               "cli"
clipr             "clipr"
cluster           "cluster"
codetools         "codetools"
colorspace        "colorspace"
commonmark        "commonmark"
compiler          "compiler"
cowplot           "cowplot"
cpp11             "cpp11"
crayon            "crayon"
crul              "crul"
curl              "curl"
data.table        "data.table"
datasets          "datasets"
DBI               "DBI"
dbplyr            "dbplyr"
desc              "desc"
diffobj           "diffobj"
digest            "digest"
dlookr            "dlookr"
DMwR2             "DMwR2"
dplyr             "dplyr"
ellipsis          "ellipsis"
evaluate          "evaluate"
extrafont         "extrafont"
extrafontdb       "extrafontdb"
fansi             "fansi"
farver            "farver"
fastmap           "fastmap"
fontawesome       "fontawesome"
fontBitstreamVera "fontBitstreamVera"
fontLiberation    "fontLiberation"
```

```
fontquiver        "fontquiver"
forcats           "forcats"
foreach           "foreach"
foreign           "foreign"
Formula           "Formula"
fs                "fs"
gdtools           "gdtools"
generics          "generics"
gfonts            "gfonts"
ggplot2           "ggplot2"
glmnet            "glmnet"
glue              "glue"
graphics          "graphics"
grDevices         "grDevices"
grid              "grid"
gridExtra         "gridExtra"
gtable            "gtable"
haven             "haven"
highr             "highr"
Hmisc             "Hmisc"
hms               "hms"
hrbrthemes        "hrbrthemes"
htmlTable         "htmlTable"
htmltools         "htmltools"
htmlwidgets       "htmlwidgets"
httpcode          "httpcode"
httpuv            "httpuv"
httr              "httr"
inum              "inum"
isoband           "isoband"
iterators         "iterators"
jomo              "jomo"
jquerylib         "jquerylib"
jsonlite          "jsonlite"
kableExtra        "kableExtra"
KernSmooth        "KernSmooth"
knitr             "knitr"
labeling          "labeling"
later             "later"
lattice           "lattice"
libcoin           "libcoin"
lifecycle         "lifecycle"
lme4              "lme4"
```

```
magrittr          "magrittr"
markdown          "markdown"
MASS              "MASS"
Matrix            "Matrix"
memoise           "memoise"
methods           "methods"
mgcv              "mgcv"
mice              "mice"
mime              "mime"
minqa             "minqa"
mitml             "mitml"
munsell           "munsell"
mvtnorm           "mvtnorm"
nlme              "nlme"
nloptr            "nloptr"
nnet              "nnet"
numDeriv          "numDeriv"
openssl           "openssl"
ordinal           "ordinal"
pacman            "pacman"
pagedown          "pagedown"
palmerpenguins    "palmerpenguins"
pan               "pan"
parallel          "parallel"
partykit          "partykit"
pillar            "pillar"
pkgconfig         "pkgconfig"
pkgload           "pkgload"
plyr              "plyr"
praise            "praise"
prettyunits       "prettyunits"
processx          "processx"
progress          "progress"
promises          "promises"
ps                "ps"
purrr             "purrr"
quantmod          "quantmod"
R6                "R6"
rappdirs          "rappdirs"
RColorBrewer      "RColorBrewer"
Rcpp              "Rcpp"
RcppEigen         "RcppEigen"
reactable         "reactable"
```

```
reactR           "reactR"
readr            "readr"
rematch2         "rematch2"
remotes          "remotes"
reshape2         "reshape2"
rlang            "rlang"
rmarkdown        "rmarkdown"
rpart            "rpart"
rprojroot        "rprojroot"
rstudioapi       "rstudioapi"
Rttf2pt1         "Rttf2pt1"
rvest            "rvest"
sass             "sass"
scales           "scales"
selectr          "selectr"
servr            "servr"
shape            "shape"
shiny            "shiny"
showtext         "showtext"
showtextdb       "showtextdb"
sourcetools      "sourcetools"
spatial          "spatial"
splines          "splines"
stats            "stats"
stats4           "stats4"
stringi          "stringi"
stringr          "stringr"
survival         "survival"
svglite          "svglite"
sys              "sys"
sysfonts         "sysfonts"
systemfonts      "systemfonts"
tcltk            "tcltk"
testthat         "testthat"
tibble           "tibble"
tidyr            "tidyr"
tidyselect       "tidyselect"
tinytex          "tinytex"
tools            "tools"
triebeard        "triebeard"
TTR              "TTR"
tzdb             "tzdb"
ucminf           "ucminf"
```

```
urltools          "urltools"
utf8              "utf8"
utils             "utils"
vctrs             "vctrs"
viridis           "viridis"
viridisLite       "viridisLite"
vroom             "vroom"
waldo             "waldo"
webshot           "webshot"
websocket         "websocket"
withr             "withr"
xfun              "xfun"
xml2              "xml2"
xtable            "xtable"
xts               "xts"
yaml              "yaml"
zoo               "zoo"
                  LibPath
AsioHeaders       "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
askpass           "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
backports         "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
base              "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
base64enc         "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
bit               "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
bit64             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
blob              "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
bookdown          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
boot              "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
brio              "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
broom             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
bslib             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
cachem            "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
callr             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
checkmate         "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
class             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
cli               "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
clipr             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
cluster           "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
codetools         "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
colorspace        "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
commonmark        "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
compiler          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
cowplot           "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
```

```
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curl              "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
data.table        "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
datasets          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
DBI               "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
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dlookr            "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
DMwR2             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
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fontBitstreamVera "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
fontLiberation    "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
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Formula           "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
fs                "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
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highr             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
```

```
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httpuv           "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
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inum             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
isoband          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
iterators        "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
jomo             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
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kableExtra       "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
KernSmooth       "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
knitr            "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
labeling         "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
later            "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
lattice          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
libcoin          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
lifecycle        "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
lme4             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
magrittr         "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
markdown         "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
MASS             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
Matrix           "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
memoise          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
methods          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
mgcv             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
mice             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
mime             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
minqa            "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
mitml            "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
munsell          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
mvtnorm          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
nlme             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
nloptr           "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
nnet             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
numDeriv         "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
openssl          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
ordinal          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
```

```
pacman            "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
pagedown          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
palmerpenguins    "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
pan               "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
parallel          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
partykit          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
pillar            "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
pkgconfig         "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
pkgload           "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
plyr              "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
praise            "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
prettyunits       "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
processx          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
progress          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
promises          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
ps                "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
purrr             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
quantmod          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
R6                "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
rappdirs          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
RColorBrewer      "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
Rcpp              "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
RcppEigen         "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
reactable         "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
reactR            "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
readr             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
rematch2          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
remotes           "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
reshape2          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
rlang             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
rmarkdown         "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
rpart             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
rprojroot         "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
rstudioapi        "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
Rttf2pt1          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
rvest             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
sass              "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
scales            "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
selectr           "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
servr             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
shape             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
shiny             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
showtext          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
```

```
showtextdb       "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
sourcetools      "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
spatial          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
splines          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
stats            "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
stats4           "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
stringi          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
stringr          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
survival         "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
svglite          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
sys              "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
sysfonts         "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
systemfonts      "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
tcltk            "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
testthat         "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
tibble           "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
tidyr            "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
tidyselect       "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
tinytex          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
tools            "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
triebeard        "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
TTR              "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
tzdb             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
ucminf           "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
urltools         "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
utf8             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
utils            "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
vctrs            "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
viridis          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
viridisLite      "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
vroom            "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
waldo            "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
webshot          "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
websocket        "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
withr            "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
xfun             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
xml2             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
xtable           "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
xts              "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
yaml             "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
zoo              "/Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library"
                 Version      Priority
AsioHeaders      "1.22.1-2"   NA
```

```
askpass           "1.2.0"      NA
backports         "1.4.1"      NA
base              "4.3.1"      "base"
base64enc         "0.1-3"      NA
bit               "4.0.5"      NA
bit64             "4.0.5"      NA
blob              "1.2.4"      NA
bookdown          "0.35"       NA
boot              "1.3-28.1"   "recommended"
brio              "1.1.3"      NA
broom             "1.0.5"      NA
bslib             "0.5.1"      NA
cachem            "1.0.8"      NA
callr             "3.7.3"      NA
checkmate         "2.2.0"      NA
class             "7.3-22"     "recommended"
cli               "3.6.1"      NA
clipr             "0.8.0"      NA
cluster           "2.1.4"      "recommended"
codetools         "0.2-19"     "recommended"
colorspace        "2.1-0"      NA
commonmark        "1.9.0"      NA
compiler          "4.3.1"      "base"
cowplot           "1.1.1"      NA
cpp11             "0.4.6"      NA
crayon            "1.5.2"      NA
crul              "1.4.0"      NA
curl              "5.0.2"      NA
data.table        "1.14.8"     NA
datasets          "4.3.1"      "base"
DBI               "1.1.3"      NA
dbplyr            "2.3.3"      NA
desc              "1.4.2"      NA
diffobj           "0.3.5"      NA
digest            "0.6.33"     NA
dlookr            "0.6.2"      NA
DMwR2             "0.0.2"      NA
dplyr             "1.1.3"      NA
ellipsis          "0.3.2"      NA
evaluate          "0.21"       NA
extrafont         "0.19"       NA
extrafontdb       "1.0"        NA
fansi             "1.0.4"      NA
```

```
farver            "2.1.1"      NA
fastmap           "1.1.1"      NA
fontawesome       "0.5.2"      NA
fontBitstreamVera "0.1.1"      NA
fontLiberation    "0.1.0"      NA
fontquiver        "0.2.1"      NA
forcats           "1.0.0"      NA
foreach           "1.5.2"      NA
foreign           "0.8-84"     "recommended"
Formula           "1.2-5"      NA
fs                "1.6.3"      NA
gdtools           "0.3.3"      NA
generics          "0.1.3"      NA
gfonts            "0.2.0"      NA
ggplot2           "3.4.3"      NA
glmnet            "4.1-8"      NA
glue              "1.6.2"      NA
graphics          "4.3.1"      "base"
grDevices         "4.3.1"      "base"
grid              "4.3.1"      "base"
gridExtra         "2.3"        NA
gtable            "0.3.4"      NA
haven             "2.5.3"      NA
highr             "0.10"       NA
Hmisc             "5.1-0"      NA
hms               "1.1.3"      NA
hrbrthemes        "0.8.0"      NA
htmlTable         "2.4.1"      NA
htmltools         "0.5.6"      NA
htmlwidgets       "1.6.2"      NA
httpcode          "0.3.0"      NA
httpuv            "1.6.11"     NA
httr              "1.4.7"      NA
inum              "1.0-5"      NA
isoband           "0.2.7"      NA
iterators         "1.0.14"     NA
jomo              "2.7-6"      NA
jquerylib         "0.1.4"      NA
jsonlite          "1.8.7"      NA
kableExtra        "1.3.4"      NA
KernSmooth        "2.23-21"    "recommended"
knitr             "1.43"       NA
labeling          "0.4.3"      NA
```

```
later             "1.3.1"      NA
lattice           "0.21-8"     "recommended"
libcoin           "1.0-9"      NA
lifecycle         "1.0.3"      NA
lme4              "1.1-34"     NA
magrittr          "2.0.3"      NA
markdown          "1.8"        NA
MASS              "7.3-60"     "recommended"
Matrix            "1.5-4.1"    "recommended"
memoise           "2.0.1"      NA
methods           "4.3.1"      "base"
mgcv              "1.8-42"     "recommended"
mice              "3.16.0"     NA
mime              "0.12"       NA
minqa             "1.2.5"      NA
mitml             "0.4-5"      NA
munsell           "0.5.0"      NA
mvtnorm           "1.2-3"      NA
nlme              "3.1-162"    "recommended"
nloptr            "2.0.3"      NA
nnet              "7.3-19"     "recommended"
numDeriv          "2016.8-1.1" NA
openssl           "2.1.0"      NA
ordinal           "2022.11-16" NA
pacman            "0.5.1"      NA
pagedown          "0.20"       NA
palmerpenguins    "0.1.1"      NA
pan               "1.9"        NA
parallel          "4.3.1"      "base"
partykit          "1.2-20"     NA
pillar            "1.9.0"      NA
pkgconfig         "2.0.3"      NA
pkgload           "1.3.2.1"    NA
plyr              "1.8.8"      NA
praise            "1.0.0"      NA
prettyunits       "1.1.1"      NA
processx          "3.8.2"      NA
progress          "1.2.2"      NA
promises          "1.2.1"      NA
ps                "1.7.5"      NA
purrr             "1.0.2"      NA
quantmod          "0.4.25"     NA
R6                "2.5.1"      NA
```

```
rappdirs          "0.3.3"      NA
RColorBrewer      "1.1-3"      NA
Rcpp              "1.0.11"     NA
RcppEigen         "0.3.3.9.3"  NA
reactable         "0.4.4"      NA
reactR            "0.4.4"      NA
readr             "2.1.4"      NA
rematch2          "2.1.2"      NA
remotes           "2.4.2.1"    NA
reshape2          "1.4.4"      NA
rlang             "1.1.1"      NA
rmarkdown         "2.24"       NA
rpart             "4.1.19"     "recommended"
rprojroot         "2.0.3"      NA
rstudioapi        "0.15.0"     NA
Rttf2pt1          "1.3.12"     NA
rvest             "1.0.3"      NA
sass              "0.4.7"      NA
scales            "1.2.1"      NA
selectr           "0.4-2"      NA
servr             "0.27"       NA
shape             "1.4.6"      NA
shiny             "1.7.5"      NA
showtext          "0.9-6"      NA
showtextdb        "3.0"        NA
sourcetools       "0.1.7-1"    NA
spatial           "7.3-16"     "recommended"
splines           "4.3.1"      "base"
stats             "4.3.1"      "base"
stats4            "4.3.1"      "base"
stringi           "1.7.12"     NA
stringr           "1.5.0"      NA
survival          "3.5-5"      "recommended"
svglite           "2.1.1"      NA
sys               "3.4.2"      NA
sysfonts          "0.8.8"      NA
systemfonts       "1.0.4"      NA
tcltk             "4.3.1"      "base"
testthat          "3.1.10"     NA
tibble            "3.2.1"      NA
tidyr             "1.3.0"      NA
tidyselect        "1.2.0"      NA
tinytex           "0.46"       NA
```

```
tools             "4.3.1"      "base"
triebeard         "0.4.1"      NA
TTR               "0.24.3"     NA
tzdb              "0.4.0"      NA
ucminf            "1.2.0"      NA
urltools          "1.7.3"      NA
utf8              "1.2.3"      NA
utils             "4.3.1"      "base"
vctrs             "0.6.3"      NA
viridis           "0.6.4"      NA
viridisLite       "0.4.2"      NA
vroom             "1.6.3"      NA
waldo             "0.5.1"      NA
webshot           "0.5.5"      NA
websocket         "1.4.1"      NA
withr             "2.5.0"      NA
xfun              "0.40"       NA
xml2              "1.3.5"      NA
xtable            "1.8-4"      NA
xts               "0.13.1"     NA
yaml              "2.3.7"      NA
zoo               "1.8-12"     NA
                  Depends
AsioHeaders       NA
askpass           NA
backports         "R (>= 3.0.0)"
base              NA
base64enc         "R (>= 2.9.0)"
bit               "R (>= 2.9.2)"
bit64             "R (>= 3.0.1), bit (>= 4.0.0), utils, methods, stats"
blob              NA
bookdown          "R (>= 3.5.0)"
boot              "R (>= 3.0.0), graphics, stats"
brio              NA
broom             "R (>= 3.5)"
bslib             "R (>= 2.10)"
cachem            NA
callr             "R (>= 3.4)"
checkmate         "R (>= 3.0.0)"
class             "R (>= 3.0.0), stats, utils"
cli               "R (>= 3.4)"
clipr             NA
cluster           "R (>= 3.5.0)"
```

```
codetools         "R (>= 2.1)"
colorspace        "R (>= 3.0.0), methods"
commonmark        NA
compiler          NA
cowplot           "R (>= 3.5.0)"
cpp11             "R (>= 3.5.0)"
crayon            NA
crul              NA
curl              "R (>= 3.0.0)"
data.table        "R (>= 3.1.0)"
datasets          NA
DBI               "methods, R (>= 3.0.0)"
dbplyr            "R (>= 3.1)"
desc              "R (>= 3.4)"
diffobj           "R (>= 3.1.0)"
digest            "R (>= 3.3.0)"
dlookr            "R (>= 3.2.0)"
DMwR2             "R(>= 3.0), methods"
dplyr             "R (>= 3.5.0)"
ellipsis          "R (>= 3.2)"
evaluate          "R (>= 3.0.2)"
extrafont         "R (>= 2.15)"
extrafontdb       "R (>= 2.14)"
fansi             "R (>= 3.1.0)"
farver            NA
fastmap           NA
fontawesome       "R (>= 3.3.0)"
fontBitstreamVera "R (>= 3.0.0)"
fontLiberation    "R (>= 3.0)"
fontquiver        "R (>= 3.0.0)"
forcats           "R (>= 3.4)"
foreach           "R (>= 2.5.0)"
foreign           "R (>= 4.0.0)"
Formula           "R (>= 2.0.0), stats"
fs                "R (>= 3.4)"
gdtools           "R (>= 4.0.0)"
generics          "R (>= 3.2)"
gfonts            "R (>= 2.10)"
ggplot2           "R (>= 3.3)"
glmnet            "R (>= 3.6.0), Matrix (>= 1.0-6)"
glue              "R (>= 3.4)"
graphics          NA
grDevices         NA
```

```
grid              NA
gridExtra         NA
gtable            "R (>= 3.5)"
haven             "R (>= 3.6)"
highr             "R (>= 3.3.0)"
Hmisc             NA
hms               NA
hrbrthemes        "R (>= 3.4.0)"
htmlTable         NA
htmltools         "R (>= 2.14.1)"
htmlwidgets       NA
httpcode          NA
httpuv            "R (>= 2.15.1)"
httr              "R (>= 3.5)"
inum              "R (>= 3.3.0)"
isoband           NA
iterators         "R (>= 2.5.0), utils"
jomo              NA
jquerylib         NA
jsonlite          "methods"
kableExtra        "R (>= 3.1.0)"
KernSmooth        "R (>= 2.5.0), stats"
knitr             "R (>= 3.3.0)"
labeling          NA
later             NA
lattice           "R (>= 4.0.0)"
libcoin           "R (>= 3.4.0)"
lifecycle         "R (>= 3.4)"
lme4              "R (>= 3.5.0), Matrix (>= 1.2-1), methods, stats"
magrittr          "R (>= 3.4.0)"
markdown          "R (>= 2.11.1)"
MASS              "R (>= 4.0), grDevices, graphics, stats, utils"
Matrix            "R (>= 3.5.0), methods"
memoise           NA
methods           NA
mgcv              "R (>= 3.6.0), nlme (>= 3.1-64)"
mice              "R (>= 2.10.0)"
mime              NA
minqa             NA
mitml             NA
munsell           NA
mvtnorm           "R(>= 3.5.0)"
nlme              "R (>= 3.5.0)"
```

```
nloptr            NA
nnet              "R (>= 3.0.0), stats, utils"
numDeriv          "R (>= 2.11.1)"
openssl           NA
ordinal           "R (>= 2.13.0), stats, methods"
pacman            "R (>= 3.5.0)"
pagedown          "R (>= 3.5.0)"
palmerpenguins    "R (>= 2.10)"
pan               NA
parallel          NA
partykit          "R (>= 3.5.0), graphics, grid, libcoin (>= 1.0-0), mvtnorm"
pillar            NA
pkgconfig         NA
pkgload           "R (>= 3.4.0)"
plyr              "R (>= 3.1.0)"
praise            NA
prettyunits       NA
processx          "R (>= 3.4.0)"
progress          NA
promises          NA
ps                "R (>= 3.4)"
purrr             "R (>= 3.5.0)"
quantmod          "R (>= 3.2.0), xts(>= 0.9-0), zoo, TTR(>= 0.2), methods"
R6                "R (>= 3.0)"
rappdirs          "R (>= 3.2)"
RColorBrewer      "R (>= 2.0.0)"
Rcpp              NA
RcppEigen         "R (>= 3.6.0)"
reactable         "R (>= 3.1)"
reactR            NA
readr             "R (>= 3.5)"
rematch2          NA
remotes           "R (>= 3.0.0)"
reshape2          "R (>= 3.1)"
rlang             "R (>= 3.5.0)"
rmarkdown         "R (>= 3.0)"
rpart             "R (>= 2.15.0), graphics, stats, grDevices"
rprojroot         "R (>= 3.0.0)"
rstudioapi        NA
Rttf2pt1          "R (>= 2.15)"
rvest             "R (>= 3.2)"
sass              NA
scales            "R (>= 3.2)"
```

```
selectr           "R (>= 3.0)"
servr             "R (>= 3.0.0)"
shape             "R (>= 2.01)"
shiny             "R (>= 3.0.2), methods"
showtext          "sysfonts (>= 0.7.1), showtextdb (>= 2.0)"
showtextdb        NA
sourcetools       "R (>= 3.0.2)"
spatial           "R (>= 3.0.0), graphics, stats, utils"
splines           NA
stats             NA
stats4            NA
stringi           "R (>= 3.1)"
stringr           "R (>= 3.3)"
survival          "R (>= 3.5.0)"
svglite           "R (>= 3.0.0)"
sys               NA
sysfonts          NA
systemfonts       "R (>= 3.2.0)"
tcltk             NA
testthat          "R (>= 3.1)"
tibble            "R (>= 3.4.0)"
tidyr             "R (>= 3.4.0)"
tidyselect        "R (>= 3.4)"
tinytex           NA
tools             NA
triebeard         NA
TTR               NA
tzdb              "R (>= 3.5.0)"
ucminf            "R (>= 3.5.0)"
urltools          "R (>= 2.10)"
utf8              "R (>= 2.10)"
utils             NA
vctrs             "R (>= 3.5.0)"
viridis           "R (>= 2.10), viridisLite (>= 0.4.0)"
viridisLite       "R (>= 2.10)"
vroom             "R (>= 3.4)"
waldo             NA
webshot           "R (>= 3.0)"
websocket         NA
withr             "R (>= 3.2.0)"
xfun              NA
xml2              "R (>= 3.1.0)"
xtable            "R (>= 2.10.0)"
```

```
xts               "R (>= 3.6.0), zoo (>= 1.7-12)"
yaml              NA
zoo               "R (>= 3.1.0), stats"
                  Imports
AsioHeaders       NA
askpass           "sys (>= 2.1)"
backports         NA
base              NA
base64enc         NA
bit               NA
bit64             NA
blob              "methods, rlang, vctrs (>= 0.2.1)"
bookdown          "htmltools (>= 0.3.6), knitr (>= 1.38), rmarkdown (>= 2.14),\njquerylib, x
boot              NA
brio              NA
broom             "backports, dplyr (>= 1.0.0), ellipsis, generics (>= 0.0.2),\nglue, lifecy
bslib             "base64enc, cachem, grDevices, htmltools (>= 0.5.4), jquerylib\n(>= 0.1.3)
cachem            "rlang, fastmap (>= 1.1.1)"
callr             "processx (>= 3.6.1), R6, utils"
checkmate         "backports (>= 1.1.0), utils"
class             "MASS"
cli               "utils"
clipr             "utils"
cluster           "graphics, grDevices, stats, utils"
codetools         NA
colorspace        "graphics, grDevices, stats"
commonmark        NA
compiler          NA
cowplot           "ggplot2 (> 2.2.1), grid, gtable, grDevices, methods, rlang,\nscales"
cpp11             NA
crayon            "grDevices, methods, utils"
crul              "curl (>= 3.3), R6 (>= 2.2.0), urltools (>= 1.6.0), httpcode\n(>= 0.2.0),
curl              NA
data.table        "methods"
datasets          NA
DBI               NA
dbplyr            "blob (>= 1.2.0), cli (>= 3.4.1), DBI (>= 1.0.0), dplyr (>=\n1.1.0), glue
desc              "cli, R6, rprojroot, utils"
diffobj           "crayon (>= 1.3.2), tools, methods, utils, stats"
digest            "utils"
dlookr            "dplyr (>= 0.7.6), showtext (>= 0.9-4), sysfonts (>= 0.7.1),\nggplot2 (>= 3
DMwR2             "xts (>= 0.9-7), zoo (>= 1.7-10), class (>= 7.3-14), rpart (>=\n4.1-10), qu
dplyr             "cli (>= 3.4.0), generics, glue (>= 1.3.2), lifecycle (>=\n1.0.3), magritt
```

```
ellipsis          "rlang (>= 0.3.0)"
evaluate          "methods"
extrafont         "extrafontdb, grDevices, utils, Rttf2pt1"
extrafontdb       NA
fansi             "grDevices, utils"
farver            NA
fastmap           NA
fontawesome       "rlang (>= 1.0.6), htmltools (>= 0.5.1.1)"
fontBitstreamVera NA
fontLiberation    NA
fontquiver        "fontBitstreamVera (>= 0.1.0), fontLiberation (>= 0.1.0)"
forcats           "cli (>= 3.4.0), glue, lifecycle, magrittr, rlang (>= 1.0.0),\ntibble"
foreach           "codetools, utils, iterators"
foreign           "methods, utils, stats"
Formula           NA
fs                "methods"
gdtools           "Rcpp (>= 0.12.12), systemfonts (>= 0.1.1), htmltools, gfonts,\ntools, curl
generics          "methods"
gfonts            "utils, htmltools, shiny, crul, jsonlite, glue, crayon"
ggplot2           "cli, glue, grDevices, grid, gtable (>= 0.1.1), isoband,\nlifecycle (> 1.0
glmnet            "methods, utils, foreach, shape, survival, Rcpp"
glue              "methods"
graphics          "grDevices"
grDevices         NA
grid              "grDevices, utils"
gridExtra         "gtable, grid, grDevices, graphics, utils"
gtable            "cli, glue, grid, lifecycle, rlang (>= 1.1.0)"
haven             "cli (>= 3.0.0), forcats (>= 0.2.0), hms, lifecycle, methods,\nreadr (>= 0
highr             "xfun (>= 0.18)"
Hmisc             "methods, ggplot2, cluster, rpart, nnet, foreign, gtable, grid,\ngridExtra
hms               "lifecycle, methods, pkgconfig, rlang (>= 1.0.2), vctrs (>=\n0.3.8)"
hrbrthemes        "ggplot2 (>= 3.3.0), grDevices, grid, scales, extrafont, knitr,\nrmarkdown
htmlTable         "stringr, knitr (>= 1.6), magrittr (>= 1.5), methods,\ncheckmate, htmlwidge
htmltools         "utils, digest, grDevices, base64enc, rlang (>= 0.4.12),\nfastmap (>= 1.1.0
htmlwidgets       "grDevices, htmltools (>= 0.5.4), jsonlite (>= 0.9.16), yaml,\nknitr (>= 1
httpcode          NA
httpuv            "Rcpp (>= 1.0.7), utils, R6, promises, later (>= 0.8.0)"
httr              "curl (>= 5.0.2), jsonlite, mime, openssl (>= 0.8), R6"
inum              "stats, libcoin (>= 1.0-0)"
isoband           "grid, utils"
iterators         NA
jomo              "stats, lme4, survival, MASS, ordinal, tibble"
jquerylib         "htmltools"
```

```
jsonlite          NA
kableExtra        "knitr (>= 1.16), magrittr, stringr (>= 1.0), xml2 (>= 1.1.1),\nrvest, rma
KernSmooth        NA
knitr             "evaluate (>= 0.15), highr, methods, tools, xfun (>= 0.39),\nyaml (>= 2.1.
labeling          "stats, graphics"
later             "Rcpp (>= 0.12.9), rlang"
lattice           "grid, grDevices, graphics, stats, utils"
libcoin           "stats, mvtnorm"
lifecycle         "cli (>= 3.4.0), glue, rlang (>= 1.0.6)"
lme4              "graphics, grid, splines, utils, parallel, MASS, lattice, boot,\nnlme (>= 
magrittr          NA
markdown          "utils, commonmark (>= 1.9.0), xfun (>= 0.38)"
MASS              "methods"
Matrix            "graphics, grid, lattice, stats, utils"
memoise           "rlang (>= 0.4.10), cachem"
methods           "utils, stats"
mgcv              "methods, stats, graphics, Matrix, splines, utils"
mice              "broom, dplyr, generics, glmnet, graphics, grDevices, lattice,\nmethods, m
mime              "tools"
minqa             "Rcpp (>= 0.9.10)"
mitml             "pan, jomo, haven, grDevices, graphics, stats, methods, utils"
munsell           "colorspace, methods"
mvtnorm           "stats"
nlme              "graphics, stats, utils, lattice"
nloptr            NA
nnet              NA
numDeriv          NA
openssl           "askpass"
ordinal           "ucminf, MASS, Matrix, numDeriv, nlme"
pacman            "remotes, methods, stats, utils"
pagedown          "rmarkdown (>= 2.13), bookdown (>= 0.8), htmltools, jsonlite,\nlater (>= 1
palmerpenguins    NA
pan               NA
parallel          "tools, compiler"
partykit          "grDevices, stats, utils, survival, Formula (>= 1.2-1), inum\n(>= 1.0-0), 
pillar            "cli (>= 2.3.0), fansi, glue, lifecycle, rlang (>= 1.0.2), utf8\n(>= 1.1.0
pkgconfig         "utils"
pkgload           "cli (>= 3.3.0), crayon, desc, fs, glue, methods, rlang (>=\n1.0.3), rproj
plyr              "Rcpp (>= 0.11.0)"
praise            NA
prettyunits       NA
processx          "ps (>= 1.2.0), R6, utils"
progress          "hms, prettyunits, R6, crayon"
```

```
promises          "fastmap (>= 1.1.0), later, magrittr (>= 1.5), R6, Rcpp, rlang,\nstats"
ps                "utils"
purrr             "cli (>= 3.6.1), lifecycle (>= 1.0.3), magrittr (>= 1.5.0),\nrlang (>= 1.1
quantmod          "curl, jsonlite(>= 1.1)"
R6                NA
rappdirs          NA
RColorBrewer      NA
Rcpp              "methods, utils"
RcppEigen         "Matrix (>= 1.1-0), Rcpp (>= 0.11.0), stats, utils"
reactable         "digest, htmltools (>= 0.5.2), htmlwidgets (>= 1.5.3),\njsonlite, reactR"
reactR            "htmltools"
readr             "cli (>= 3.2.0), clipr, crayon, hms (>= 0.4.1), lifecycle (>=\n0.2.0), metl
rematch2          "tibble"
remotes           "methods, stats, tools, utils"
reshape2          "plyr (>= 1.8.1), Rcpp, stringr"
rlang             "utils"
rmarkdown         "bslib (>= 0.2.5.1), evaluate (>= 0.13), fontawesome (>=\n0.5.0), htmltools
rpart             NA
rprojroot         NA
rstudioapi        NA
Rttf2pt1          NA
rvest             "glue, cli, httr (>= 0.5), lifecycle (>= 1.0.0), magrittr,\nrlang (>= 1.0.0
sass              "fs (>= 1.2.4), rlang (>= 0.4.10), htmltools (>= 0.5.1), R6,\nrappdirs"
scales            "farver (>= 2.0.3), labeling, lifecycle, munsell (>= 0.5), R6,\nRColorBrewe
selectr           "methods, stringr, R6"
servr             "mime (>= 0.2), httpuv (>= 1.5.2), xfun, jsonlite"
shape             "stats, graphics, grDevices"
shiny             "utils, grDevices, httpuv (>= 1.5.2), mime (>= 0.3), jsonlite\n(>= 0.9.16)
showtext          "grDevices"
showtextdb        "sysfonts (>= 0.7), utils"
sourcetools       NA
spatial           NA
splines           "graphics, stats"
stats             "utils, grDevices, graphics"
stats4            "graphics, methods, stats"
stringi           "tools, utils, stats"
stringr           "cli, glue (>= 1.6.1), lifecycle (>= 1.0.3), magrittr, rlang\n(>= 1.0.0), s
survival          "graphics, Matrix, methods, splines, stats, utils"
svglite           "systemfonts (>= 1.0.0)"
sys               NA
sysfonts          NA
systemfonts       NA
tcltk             "utils"
```

```
testthat          "brio, callr (>= 3.5.1), cli (>= 3.4.0), desc, digest, ellipsis\n(>= 0.2.0)
tibble            "fansi (>= 0.4.0), lifecycle (>= 1.0.0), magrittr, methods,\npillar (>= 1.8
tidyr             "cli (>= 3.4.1), dplyr (>= 1.0.10), glue, lifecycle (>= 1.0.3),\nmagrittr,
tidyselect        "cli (>= 3.3.0), glue (>= 1.3.0), lifecycle (>= 1.0.3), rlang\n(>= 1.0.4),
tinytex           "xfun (>= 0.29)"
tools             NA
triebeard         "Rcpp"
TTR               "xts (>= 0.10-0), zoo, curl"
tzdb              NA
ucminf            NA
urltools          "Rcpp, methods, triebeard"
utf8              NA
utils             NA
vctrs             "cli (>= 3.4.0), glue, lifecycle (>= 1.0.3), rlang (>= 1.1.0)"
viridis           "ggplot2 (>= 1.0.1), gridExtra"
viridisLite       NA
vroom             "bit64, cli (>= 3.2.0), crayon, glue, hms, lifecycle (>=\n1.0.3), methods,
waldo             "cli, diffobj (>= 0.3.4), fansi, glue, methods, rematch2, rlang\n(>= 1.0.0)
webshot           "magrittr, jsonlite, callr"
websocket         "R6, later (>= 1.2.0)"
withr             "graphics, grDevices, stats"
xfun              "stats, tools"
xml2              "methods"
xtable            "stats, utils"
xts               "methods"
yaml              NA
zoo               "utils, graphics, grDevices, lattice (>= 0.20-27)"
                  LinkingTo
AsioHeaders       NA
askpass           NA
backports         NA
base              NA
base64enc         NA
bit               NA
bit64             NA
blob              NA
bookdown          NA
boot              NA
brio              NA
broom             NA
bslib             NA
cachem            NA
callr             NA
```

```
checkmate         NA
class             NA
cli               NA
clipr             NA
cluster           NA
codetools         NA
colorspace        NA
commonmark        NA
compiler          NA
cowplot           NA
cpp11             NA
crayon            NA
crul              NA
curl              NA
data.table        NA
datasets          NA
DBI               NA
dbplyr            NA
desc              NA
diffobj           NA
digest            NA
dlookr            NA
DMwR2             NA
dplyr             NA
ellipsis          NA
evaluate          NA
extrafont         NA
extrafontdb       NA
fansi             NA
farver            NA
fastmap           NA
fontawesome       NA
fontBitstreamVera NA
fontLiberation    NA
fontquiver        NA
forcats           NA
foreach           NA
foreign           NA
Formula           NA
fs                NA
gdtools           "Rcpp"
generics          NA
gfonts            NA
```

```
ggplot2           NA
glmnet            "RcppEigen, Rcpp"
glue              NA
graphics          NA
grDevices         NA
grid              NA
gridExtra         NA
gtable            NA
haven             "cpp11"
highr             NA
Hmisc             NA
hms               NA
hrbrthemes        NA
htmlTable         NA
htmltools         NA
htmlwidgets       NA
httpcode          NA
httpuv            "Rcpp, later"
httr              NA
inum              NA
isoband           NA
iterators         NA
jomo              NA
jquerylib         NA
jsonlite          NA
kableExtra        NA
KernSmooth        NA
knitr             NA
labeling          NA
later             "Rcpp"
lattice           NA
libcoin           "mvtnorm"
lifecycle         NA
lme4              "Rcpp (>= 0.10.5), RcppEigen"
magrittr          NA
markdown          NA
MASS              NA
Matrix            NA
memoise           NA
methods           NA
mgcv              NA
mice              "cpp11, Rcpp"
mime              NA
```

```
minqa             "Rcpp"
mitml             NA
munsell           NA
mvtnorm           NA
nlme              NA
nloptr            "testthat"
nnet              NA
numDeriv          NA
openssl           NA
ordinal           NA
pacman            NA
pagedown          NA
palmerpenguins    NA
pan               NA
parallel          NA
partykit          NA
pillar            NA
pkgconfig         NA
pkgload           NA
plyr              "Rcpp"
praise            NA
prettyunits       NA
processx          NA
progress          NA
promises          "later, Rcpp"
ps                NA
purrr             "cli"
quantmod          NA
R6                NA
rappdirs          NA
RColorBrewer      NA
Rcpp              NA
RcppEigen         "Rcpp"
reactable         NA
reactR            NA
readr             "cpp11, tzdb (>= 0.1.1)"
rematch2          NA
remotes           NA
reshape2          "Rcpp"
rlang             NA
rmarkdown         NA
rpart             NA
rprojroot         NA
```

```
rstudioapi        NA
Rttf2pt1          NA
rvest             NA
sass              NA
scales            NA
selectr           NA
servr             NA
shape             NA
shiny             NA
showtext          NA
showtextdb        NA
sourcetools       NA
spatial           NA
splines           NA
stats             NA
stats4            NA
stringi           NA
stringr           NA
survival          NA
svglite           "cpp11, systemfonts"
sys               NA
sysfonts          NA
systemfonts       "cpp11 (>= 0.2.1)"
tcltk             NA
testthat          NA
tibble            NA
tidyr             "cpp11 (>= 0.4.0)"
tidyselect        NA
tinytex           NA
tools             NA
triebeard         "Rcpp"
TTR               "xts"
tzdb              "cpp11 (>= 0.4.2)"
ucminf            NA
urltools          "Rcpp"
utf8              NA
utils             NA
vctrs             NA
viridis           NA
viridisLite       NA
vroom             "cpp11 (>= 0.2.0), progress (>= 1.2.1), tzdb (>= 0.1.1)"
waldo             NA
webshot           NA
```

```
websocket         "cpp11, AsioHeaders, later"
withr             NA
xfun              NA
xml2              NA
xtable            NA
xts               "zoo"
yaml              NA
zoo               NA
                  Suggests
AsioHeaders       NA
askpass           "testthat"
backports         NA
base              "methods"
base64enc         NA
bit               "testthat (>= 0.11.0), roxygen2, knitr, rmarkdown,\nmicrobenchmark, bit64
bit64             NA
blob              "covr, crayon, pillar (>= 1.2.1), testthat"
bookdown          "bslib (>= 0.2.4), downlit (>= 0.4.0), htmlwidgets, jsonlite,\nrstudioapi,
boot              "MASS, survival"
brio              "covr, testthat (>= 2.1.0)"
broom             "AER, AUC, bbmle, betareg, biglm, binGroup, boot, btergm (>=\n1.10.6), car
bslib             "bsicons, curl, fontawesome, ggplot2, knitr, magrittr,\nrappdirs, rmarkdow
cachem            "testthat"
callr             "asciicast, cli (>= 1.1.0), covr, mockery, ps, rprojroot,\nspelling, testth
checkmate         "R6, fastmatch, data.table (>= 1.9.8), devtools, ggplot2,\nknitr, magrittr
class             NA
cli               "callr, covr, crayon, digest, glue (>= 1.6.0), grDevices,\nhtmltools, htmlw
clipr             "covr, knitr, rmarkdown, rstudioapi (>= 0.5), testthat (>=\n2.0.0)"
cluster           "MASS, Matrix"
codetools         NA
colorspace        "datasets, utils, KernSmooth, MASS, kernlab, mvtnorm, vcd,\ntcltk, shiny, s
commonmark        "curl, testthat, xml2"
compiler          NA
cowplot           "Cairo, covr, dplyr, forcats, gridGraphics (>= 0.4-0), knitr,\nlattice, mag
cpp11             "bench, brio, callr, cli, covr, decor, desc, ggplot2, glue,\nknitr, lobstr
crayon            "mockery, rstudioapi, testthat, withr"
crul              "testthat, roxygen2 (>= 7.1.1), fauxpas (>= 0.1.0), webmockr\n(>= 0.1.0), h
curl              "spelling, testthat (>= 1.0.0), knitr, jsonlite, rmarkdown,\nmagrittr, http
data.table        "bit64 (>= 4.0.0), bit (>= 4.0.4), curl, R.utils, xts,\nnanotime, zoo (>= 1
datasets          NA
DBI               "blob, covr, DBItest, dbplyr, downlit, dplyr, glue, hms,\nknitr, magrittr,
dbplyr            "bit64, covr, knitr, Lahman, nycflights13, odbc, RMariaDB (>=\n1.0.2), rmar
desc              "callr, covr, gh, spelling, testthat, whoami, withr"
```

```
diffobj           "knitr, rmarkdown"
digest            "tinytest, simplermarkdown"
dlookr            "DBI, classInt, dbplyr, forecast (>= 8.3), Hmisc, ISLR,\nnycflights13, ppsr
DMwR2             NA
dplyr             "bench, broom, callr, covr, DBI, dbplyr (>= 2.2.1), ggplot2,\nknitr, Lahman
ellipsis          "covr, testthat"
evaluate          "covr, ggplot2, lattice, rlang, testthat (>= 3.0.0), withr"
extrafont         "fontcm"
extrafontdb       NA
fansi             "unitizer, knitr, rmarkdown"
farver            "covr, testthat (>= 3.0.0)"
fastmap           "testthat (>= 2.1.1)"
fontawesome       "covr, dplyr (>= 1.0.8), knitr (>= 1.31), testthat (>= 3.0.0),\nrsvg"
fontBitstreamVera NA
fontLiberation    NA
fontquiver        "testthat, htmltools"
forcats           "covr, dplyr, ggplot2, knitr, readr, rmarkdown, testthat (>=\n3.0.0), withr
foreach           "randomForest, doMC, doParallel, testthat, knitr, rmarkdown"
foreign           NA
Formula           NA
fs                "covr, crayon, knitr, pillar (>= 1.0.0), rmarkdown, spelling,\ntestthat (>=
gdtools           "testthat, methods"
generics          "covr, pkgload, testthat (>= 3.0.0), tibble, withr"
gfonts            "knitr, rmarkdown, testthat (>= 2.1.0), vcr, covr"
ggplot2           "covr, dplyr, ggplot2movies, hexbin, Hmisc, knitr, lattice,\nmapproj, maps
glmnet            "knitr, lars, testthat, xfun, rmarkdown"
glue              "covr, crayon, DBI, dplyr, forcats, ggplot2, knitr, magrittr,\nmicrobenchma
graphics          NA
grDevices         "KernSmooth"
grid              NA
gridExtra         "ggplot2, egg, lattice, knitr, testthat"
gtable            "covr, ggplot2, knitr, profvis, rmarkdown, testthat (>= 3.0.0)"
haven             "covr, crayon, fs, knitr, pillar (>= 1.4.0), rmarkdown,\ntestthat (>= 3.0.0
highr             "knitr, markdown, testit"
Hmisc             "survival, qreport, acepack, chron, rms, mice, rstudioapi,\ntables, plotly
hms               "crayon, lubridate, pillar (>= 1.1.0), testthat (>= 3.0.0)"
hrbrthemes        "testthat, dplyr, gridExtra, hunspell, stringi, gcookbook,\nclipr, vdiffr,
htmlTable         "testthat, XML, xml2, Hmisc, reshape, rmarkdown, chron,\nlubridate, tibble
htmltools         "markdown, testthat, withr, Cairo, ragg, shiny"
htmlwidgets       "testthat"
httpcode          "testthat"
httpuv            "testthat, callr, curl, websocket"
httr              "covr, httpuv, jpeg, knitr, png, readr, rmarkdown, testthat\n(>= 0.8.0), xm
```

```
inum              NA
isoband           "covr, ggplot2, knitr, magick, microbenchmark, rmarkdown, sf,\ntestthat, xm
iterators         "RUnit, foreach"
jomo              "mitml"
jquerylib         "testthat"
jsonlite          "httr, vctrs, testthat, knitr, rmarkdown, R.rsp, sf"
kableExtra        "testthat, magick, formattable, sparkline"
KernSmooth        "MASS, carData"
knitr             "bslib, codetools, DBI (>= 0.4-1), digest, formatR, gifski,\ngridSVG, htmlw
labeling          NA
later             "knitr, rmarkdown, testthat (>= 2.1.0)"
lattice           "KernSmooth, MASS, latticeExtra, colorspace"
libcoin           "coin"
lifecycle         "covr, crayon, knitr, lintr, rmarkdown, testthat (>= 3.0.1),\ntibble, tidyv
lme4              "knitr, rmarkdown, MEMSS, testthat (>= 0.8.1), ggplot2,\nmlmRev, optimx (>=
magrittr          "covr, knitr, rlang, rmarkdown, testthat"
markdown          "knitr, rmarkdown (>= 2.18), yaml, RCurl"
MASS              "lattice, nlme, nnet, survival"
Matrix            "MASS, expm"
memoise           "digest, aws.s3, covr, googleAuthR, googleCloudStorageR, httr,\ntestthat"
methods           "codetools"
mgcv              "parallel, survival, MASS"
mice              "broom.mixed, future, furrr, haven, knitr, lme4, MASS,\nmiceadds, pan, para
mime              NA
minqa             NA
mitml             "mice, miceadds, Amelia, lme4, nlme, lavaan, geepack, glmmTMB,\nsurvival, M
munsell           "ggplot2, testthat"
mvtnorm           "qrng, numDeriv"
nlme              "Hmisc, MASS, SASmixed"
nloptr            "knitr, rmarkdown, xml2, testthat (>= 3.0.0), covr"
nnet              "MASS"
numDeriv          NA
openssl           "curl, testthat (>= 2.1.0), digest, knitr, rmarkdown,\njsonlite, jose, sodi
ordinal           "lme4, nnet, xtable, testthat (>= 0.8), tools"
pacman            "BiocManager, knitr, lattice, testthat (>= 0.9.0), XML"
pagedown          "promises, testit, xaringan, pdftools, revealjs, covr, xml2"
palmerpenguins    "knitr, rmarkdown, tibble, ggplot2, dplyr, tidyr, recipes"
pan               "mitools, lme4"
parallel          "methods"
partykit          "XML, pmml, rJava, sandwich, strucchange, vcd, AER, mlbench,\nTH.data (>= 1
pillar            "bit64, DBI, debugme, DiagrammeR, dplyr, formattable, ggplot2,\nknitr, lubr
pkgconfig         "covr, testthat, disposables (>= 1.0.3)"
pkgload           "bitops, covr, mathjaxr, mockr, pak, pkgbuild, Rcpp, remotes,\nrstudioapi,
```

```
plyr             "abind, covr, doParallel, foreach, iterators, itertools,\ntcltk, testthat"
praise           "testthat"
prettyunits      "codetools, covr, testthat"
processx         "callr (>= 3.7.3), cli (>= 3.3.0), codetools, covr, curl,\ndebugme, paralle
progress         "Rcpp, testthat, withr"
promises         "future (>= 1.21.0), knitr, purrr, rmarkdown, spelling,\ntestthat, vembedr
ps               "callr, covr, curl, pillar, pingr, processx (>= 3.1.0), R6,\nrlang, testtha
purrr            "covr, dplyr (>= 0.7.8), httr, knitr, lubridate, rmarkdown,\ntestthat (>= 3
quantmod         "DBI,RMySQL,RSQLite,timeSeries,xml2,downloader"
R6               "testthat, pryr"
rappdirs         "roxygen2, testthat (>= 3.0.0), covr, withr"
RColorBrewer     NA
Rcpp             "tinytest, inline, rbenchmark, pkgKitten (>= 0.1.2)"
RcppEigen        "inline, tinytest, pkgKitten, microbenchmark"
reactable        "covr, crosstalk, dplyr, fontawesome, knitr, leaflet, MASS,\nrmarkdown, shi
reactR           "htmlwidgets (>= 1.5.3), rmarkdown, shiny, V8, knitr, usethis,\njsonlite"
readr            "covr, curl, datasets, knitr, rmarkdown, spelling, stringi,\ntestthat (>= 3
rematch2         "covr, testthat"
remotes          "brew, callr, codetools, curl, covr, git2r (>= 0.23.0), knitr,\nmockery, pl
reshape2         "covr, lattice, testthat (>= 0.8.0)"
rlang            "cli (>= 3.1.0), covr, crayon, fs, glue, knitr, magrittr,\nmethods, pillar
rmarkdown        "digest, dygraphs, fs, rsconnect, downlit (>= 0.4.0), katex\n(>= 1.4.0), sa
rpart            "survival"
rprojroot        "covr, knitr, lifecycle, mockr, rmarkdown, testthat (>=\n3.0.0), withr"
rstudioapi       "testthat, knitr, rmarkdown, clipr, covr"
Rttf2pt1         NA
rvest            "covr, knitr, readr, repurrrsive, rmarkdown, spelling, stringi\n(>= 0.3.1)
sass             "testthat, knitr, rmarkdown, withr, shiny, curl"
scales           "bit64, covr, dichromat, ggplot2, hms (>= 0.5.0), stringi,\ntestthat (>= 3
selectr          "testthat, XML, xml2"
servr            "tools, later, rstudioapi, knitr (>= 1.9), rmarkdown"
shape            NA
shiny            "datasets, Cairo (>= 1.5-5), testthat (>= 3.0.0), knitr (>=\n1.6), markdown
showtext         "knitr, rmarkdown, prettydoc, curl, jsonlite"
showtextdb       "curl"
sourcetools      "testthat"
spatial          "MASS"
splines          "Matrix, methods"
stats            "MASS, Matrix, SuppDists, methods, stats4"
stats4           NA
stringi          NA
stringr          "covr, htmltools, htmlwidgets, knitr, rmarkdown, testthat (>=\n3.0.0)"
survival         NA
```

```
svglite           "covr, fontquiver (>= 0.2.0), htmltools, knitr, rmarkdown,\ntestthat, xml2
sys               "unix (>= 1.4), spelling, testthat"
sysfonts          "curl, jsonlite"
systemfonts       "testthat (>= 2.1.0), covr, knitr, rmarkdown, tools"
tcltk             NA
testthat          "covr, curl (>= 0.9.5), diffviewer (>= 0.1.0), knitr,\nrmarkdown, rstudioap
tibble            "bench, bit64, blob, brio, callr, cli, covr, crayon (>=\n1.3.4), Diagrammer
tidyr             "covr, data.table, knitr, readr, repurrrsive (>= 1.1.0),\nrmarkdown, testth
tidyselect        "covr, crayon, dplyr, knitr, magrittr, rmarkdown, stringr,\ntestthat (>= 3
tinytex           "testit, rstudioapi"
tools             "codetools, methods, xml2, curl, commonmark, knitr, xfun, mathjaxr, V8"
triebeard         "knitr, rmarkdown, testthat"
TTR               "RUnit"
tzdb              "covr, testthat (>= 3.0.0)"
ucminf            "numDeriv"
urltools          "testthat, knitr"
utf8              "cli, covr, knitr, rlang, rmarkdown, testthat (>= 3.0.0),\nwithr"
utils             "methods, xml2, commonmark, knitr"
vctrs             "bit64, covr, crayon, dplyr (>= 0.8.5), generics, knitr,\npillar (>= 1.4.4)
viridis           "hexbin (>= 1.27.0), scales, MASS, knitr, dichromat,\ncolorspace, httr, map
viridisLite       "hexbin (>= 1.27.0), ggplot2 (>= 1.0.1), testthat, covr"
vroom             "archive, bench (>= 1.1.0), covr, curl, dplyr, forcats, fs,\nggplot2, knitr
waldo             "covr, R6, testthat (>= 3.0.0), withr, xml2"
webshot           "httpuv, knitr, rmarkdown, shiny, testthat (>= 3.0.0)"
websocket         "httpuv, testthat, knitr, rmarkdown"
withr             "callr, covr, DBI, knitr, lattice, methods, rlang, rmarkdown\n(>= 2.12), RS
xfun              "testit, parallel, codetools, rstudioapi, tinytex (>= 0.30),\nmime, markdow
xml2              "covr, curl, httr, knitr, magrittr, mockery, rmarkdown,\ntestthat (>= 2.1.0
xtable            "knitr, plm, zoo, survival"
xts               "timeSeries, timeDate, tseries, chron, tinytest"
yaml              "RUnit"
zoo               "AER, coda, chron, ggplot2 (>= 3.0.0), mondate, scales,\nstinepack, strucch
                  Enhances
AsioHeaders       NA
askpass           NA
backports         NA
base              NA
base64enc         "png"
bit               NA
bit64             NA
blob              NA
bookdown          NA
boot              NA
```

```
brio              NA
broom             NA
bslib             NA
cachem            NA
callr             NA
checkmate         NA
class             NA
cli               NA
clipr             NA
cluster           NA
codetools         NA
colorspace        NA
commonmark        NA
compiler          NA
cowplot           NA
cpp11             NA
crayon            NA
crul              NA
curl              NA
data.table        NA
datasets          NA
DBI               NA
dbplyr            NA
desc              NA
diffobj           NA
digest            NA
dlookr            NA
DMwR2             NA
dplyr             NA
ellipsis          NA
evaluate          NA
extrafont         NA
extrafontdb       NA
fansi             NA
farver            NA
fastmap           NA
fontawesome       NA
fontBitstreamVera NA
fontLiberation    NA
fontquiver        NA
forcats           NA
foreach           NA
foreign           NA
```

```
Formula           NA
fs                NA
gdtools           NA
generics          NA
gfonts            NA
ggplot2           "sp"
glmnet            NA
glue              NA
graphics          NA
grDevices         NA
grid              NA
gridExtra         NA
gtable            NA
haven             NA
highr             NA
Hmisc             NA
hms               NA
hrbrthemes        NA
htmlTable         NA
htmltools         "knitr"
htmlwidgets       "shiny (>= 1.1)"
httpcode          NA
httpuv            NA
httr              NA
inum              NA
isoband           NA
iterators         NA
jomo              NA
jquerylib         NA
jsonlite          NA
kableExtra        NA
KernSmooth        NA
knitr             NA
labeling          NA
later             NA
lattice           "chron"
libcoin           NA
lifecycle         NA
lme4              NA
magrittr          NA
markdown          NA
MASS              NA
Matrix            "MatrixModels, SparseM, graph, igraph, maptools, sfsmisc, sp,\nspdep"
```

```
memoise           NA
methods           NA
mgcv              NA
mice              NA
mime              NA
minqa             NA
mitml             NA
munsell           NA
mvtnorm           NA
nlme              NA
nloptr            NA
nnet              NA
numDeriv          NA
openssl           NA
ordinal           NA
pacman            NA
pagedown          NA
palmerpenguins    NA
pan               NA
parallel          "snow, Rmpi"
partykit          NA
pillar            NA
pkgconfig         NA
pkgload           NA
plyr              NA
praise            NA
prettyunits       NA
processx          NA
progress          NA
promises          NA
ps                NA
purrr             NA
quantmod          NA
R6                NA
rappdirs          NA
RColorBrewer      NA
Rcpp              NA
RcppEigen         NA
reactable         NA
reactR            NA
readr             NA
rematch2          NA
remotes           NA
```

```
reshape2          NA
rlang             "winch"
rmarkdown         NA
rpart             NA
rprojroot         NA
rstudioapi        NA
Rttf2pt1          NA
rvest             NA
sass              NA
scales            NA
selectr           NA
servr             NA
shape             NA
shiny             NA
showtext          NA
showtextdb        NA
sourcetools       NA
spatial           NA
splines           NA
stats             NA
stats4            NA
stringi           NA
stringr           NA
survival          NA
svglite           NA
sys               NA
sysfonts          NA
systemfonts       NA
tcltk             NA
testthat          NA
tibble            NA
tidyr             NA
tidyselect        NA
tinytex           NA
tools             NA
triebeard         NA
TTR               "quantmod"
tzdb              NA
ucminf            NA
urltools          NA
utf8              NA
utils             NA
vctrs             NA
```

viridis	NA	
viridisLite	NA	
vroom	NA	
waldo	NA	
webshot	NA	
websocket	NA	
withr	NA	
xfun	NA	
xml2	NA	
xtable	NA	
xts	NA	
yaml	NA	
zoo	NA	
	License	License_is_FOSS
AsioHeaders	"BSL-1.0"	NA
askpass	"MIT + file LICENSE"	NA
backports	"GPL-2 | GPL-3"	NA
base	"Part of R 4.3.1"	NA
base64enc	"GPL-2 | GPL-3"	NA
bit	"GPL-2 | GPL-3"	NA
bit64	"GPL-2 | GPL-3"	NA
blob	"MIT + file LICENSE"	NA
bookdown	"GPL-3"	NA
boot	"Unlimited"	NA
brio	"MIT + file LICENSE"	NA
broom	"MIT + file LICENSE"	NA
bslib	"MIT + file LICENSE"	NA
cachem	"MIT + file LICENSE"	NA
callr	"MIT + file LICENSE"	NA
checkmate	"BSD_3_clause + file LICENSE"	NA
class	"GPL-2 | GPL-3"	NA
cli	"MIT + file LICENSE"	NA
clipr	"GPL-3"	NA
cluster	"GPL (>= 2)"	NA
codetools	"GPL"	NA
colorspace	"BSD_3_clause + file LICENSE"	NA
commonmark	"BSD_2_clause + file LICENSE"	NA
compiler	"Part of R 4.3.1"	NA
cowplot	"GPL-2"	NA
cpp11	"MIT + file LICENSE"	NA
crayon	"MIT + file LICENSE"	NA
crul	"MIT + file LICENSE"	NA
curl	"MIT + file LICENSE"	NA

data.table	"MPL-2.0 | file LICENSE"	NA
datasets	"Part of R 4.3.1"	NA
DBI	"LGPL (>= 2.1)"	NA
dbplyr	"MIT + file LICENSE"	NA
desc	"MIT + file LICENSE"	NA
diffobj	"GPL-2 | GPL-3"	NA
digest	"GPL (>= 2)"	NA
dlookr	"GPL-2 | file LICENSE"	NA
DMwR2	"GPL (>= 2)"	NA
dplyr	"MIT + file LICENSE"	NA
ellipsis	"MIT + file LICENSE"	NA
evaluate	"MIT + file LICENSE"	NA
extrafont	"GPL-2"	NA
extrafontdb	"GPL-2"	NA
fansi	"GPL-2 | GPL-3"	NA
farver	"MIT + file LICENSE"	NA
fastmap	"MIT + file LICENSE"	NA
fontawesome	"MIT + file LICENSE"	NA
fontBitstreamVera	"file LICENCE"	"yes"
fontLiberation	"file LICENSE"	"yes"
fontquiver	"GPL-3 | file LICENSE"	NA
forcats	"MIT + file LICENSE"	NA
foreach	"Apache License (== 2.0)"	NA
foreign	"GPL (>= 2)"	NA
Formula	"GPL-2 | GPL-3"	NA
fs	"MIT + file LICENSE"	NA
gdtools	"GPL-3 | file LICENSE"	NA
generics	"MIT + file LICENSE"	NA
gfonts	"GPL-3"	NA
ggplot2	"MIT + file LICENSE"	NA
glmnet	"GPL-2"	NA
glue	"MIT + file LICENSE"	NA
graphics	"Part of R 4.3.1"	NA
grDevices	"Part of R 4.3.1"	NA
grid	"Part of R 4.3.1"	NA
gridExtra	"GPL (>= 2)"	NA
gtable	"MIT + file LICENSE"	NA
haven	"MIT + file LICENSE"	NA
highr	"GPL"	NA
Hmisc	"GPL (>= 2)"	NA
hms	"MIT + file LICENSE"	NA
hrbrthemes	"MIT + file LICENSE"	NA
htmlTable	"GPL (>= 3)"	NA

```
htmltools         "GPL (>= 2)"                          NA
htmlwidgets       "MIT + file LICENSE"                  NA
httpcode          "MIT + file LICENSE"                  NA
httpuv            "GPL (>= 2) | file LICENSE"           NA
httr              "MIT + file LICENSE"                  NA
inum              "GPL-2"                               NA
isoband           "MIT + file LICENSE"                  NA
iterators         "Apache License (== 2.0)"             NA
jomo              "GPL-2"                               NA
jquerylib         "MIT + file LICENSE"                  NA
jsonlite          "MIT + file LICENSE"                  NA
kableExtra        "MIT + file LICENSE"                  NA
KernSmooth        "Unlimited"                           NA
knitr             "GPL"                                 NA
labeling          "MIT + file LICENSE | Unlimited"      NA
later             "MIT + file LICENSE"                  NA
lattice           "GPL (>= 2)"                          NA
libcoin           "GPL-2"                               NA
lifecycle         "MIT + file LICENSE"                  NA
lme4              "GPL (>= 2)"                          NA
magrittr          "MIT + file LICENSE"                  NA
markdown          "MIT + file LICENSE"                  NA
MASS              "GPL-2 | GPL-3"                       NA
Matrix            "GPL (>= 2) | file LICENCE"           NA
memoise           "MIT + file LICENSE"                  NA
methods           "Part of R 4.3.1"                     NA
mgcv              "GPL (>= 2)"                          NA
mice              "GPL (>= 2)"                          NA
mime              "GPL"                                 NA
minqa             "GPL-2"                               NA
mitml             "GPL (>= 2)"                          NA
munsell           "MIT + file LICENSE"                  NA
mvtnorm           "GPL-2"                               NA
nlme              "GPL (>= 2)"                          NA
nloptr            "LGPL (>= 3)"                         NA
nnet              "GPL-2 | GPL-3"                       NA
numDeriv          "GPL-2"                               NA
openssl           "MIT + file LICENSE"                  NA
ordinal           "GPL (>= 2)"                          NA
pacman            "GPL-2"                               NA
pagedown          "MIT + file LICENSE"                  NA
palmerpenguins    "CC0"                                 NA
pan               "GPL-3"                               NA
```

```
parallel          "Part of R 4.3.1"                       NA
partykit          "GPL-2 | GPL-3"                         NA
pillar            "MIT + file LICENSE"                    NA
pkgconfig         "MIT + file LICENSE"                    NA
pkgload           "GPL-3"                                 NA
plyr              "MIT + file LICENSE"                    NA
praise            "MIT + file LICENSE"                    NA
prettyunits       "MIT + file LICENSE"                    NA
processx          "MIT + file LICENSE"                    NA
progress          "MIT + file LICENSE"                    NA
promises          "MIT + file LICENSE"                    NA
ps                "MIT + file LICENSE"                    NA
purrr             "MIT + file LICENSE"                    NA
quantmod          "GPL-3"                                 NA
R6                "MIT + file LICENSE"                    NA
rappdirs          "MIT + file LICENSE"                    NA
RColorBrewer      "Apache License 2.0"                    NA
Rcpp              "GPL (>= 2)"                            NA
RcppEigen         "GPL (>= 2) | file LICENSE"             NA
reactable         "MIT + file LICENSE"                    NA
reactR            "MIT + file LICENSE"                    NA
readr             "MIT + file LICENSE"                    NA
rematch2          "MIT + file LICENSE"                    NA
remotes           "MIT + file LICENSE"                    NA
reshape2          "MIT + file LICENSE"                    NA
rlang             "MIT + file LICENSE"                    NA
rmarkdown         "GPL-3"                                 NA
rpart             "GPL-2 | GPL-3"                         NA
rprojroot         "MIT + file LICENSE"                    NA
rstudioapi        "MIT + file LICENSE"                    NA
Rttf2pt1          "file LICENSE"                          "yes"
rvest             "MIT + file LICENSE"                    NA
sass              "MIT + file LICENSE"                    NA
scales            "MIT + file LICENSE"                    NA
selectr           "BSD_3_clause + file LICENCE"           NA
servr             "GPL"                                   NA
shape             "GPL (>= 3)"                            NA
shiny             "GPL-3 | file LICENSE"                  NA
showtext          "Apache License (>= 2.0)"               NA
showtextdb        "Apache License (>= 2.0)"               NA
sourcetools       "MIT + file LICENSE"                    NA
spatial           "GPL-2 | GPL-3"                         NA
splines           "Part of R 4.3.1"                       NA
```

```
stats             "Part of R 4.3.1"                        NA
stats4            "Part of R 4.3.1"                        NA
stringi           "file LICENSE"                           "yes"
stringr           "MIT + file LICENSE"                     NA
survival          "LGPL (>= 2)"                            NA
svglite           "GPL (>= 2)"                             NA
sys               "MIT + file LICENSE"                     NA
sysfonts          "GPL-2"                                  NA
systemfonts       "MIT + file LICENSE"                     NA
tcltk             "Part of R 4.3.1"                        NA
testthat          "MIT + file LICENSE"                     NA
tibble            "MIT + file LICENSE"                     NA
tidyr             "MIT + file LICENSE"                     NA
tidyselect        "MIT + file LICENSE"                     NA
tinytex           "MIT + file LICENSE"                     NA
tools             "Part of R 4.3.1"                        NA
triebeard         "MIT + file LICENSE"                     NA
TTR               "GPL (>= 2)"                             NA
tzdb              "MIT + file LICENSE"                     NA
ucminf            "GPL (>= 2)"                             NA
urltools          "MIT + file LICENSE"                     NA
utf8              "Apache License (== 2.0) | file LICENSE" NA
utils             "Part of R 4.3.1"                        NA
vctrs             "MIT + file LICENSE"                     NA
viridis           "MIT + file LICENSE"                     NA
viridisLite       "MIT + file LICENSE"                     NA
vroom             "MIT + file LICENSE"                     NA
waldo             "MIT + file LICENSE"                     NA
webshot           "GPL-2"                                  NA
websocket         "GPL-2"                                  NA
withr             "MIT + file LICENSE"                     NA
xfun              "MIT + file LICENSE"                     NA
xml2              "MIT + file LICENSE"                     NA
xtable            "GPL (>= 2)"                             NA
xts               "GPL (>= 2)"                             NA
yaml              "BSD_3_clause + file LICENSE"            NA
zoo               "GPL-2 | GPL-3"                          NA
                  License_restricts_use OS_type MD5sum NeedsCompilation Built
AsioHeaders       NA                    NA      NA     "no"             "4.3.0"
askpass           NA                    NA      NA     "yes"            "4.3.0"
backports         NA                    NA      NA     "yes"            "4.3.0"
base              NA                    NA      NA     NA               "4.3.1"
base64enc         NA                    NA      NA     "yes"            "4.3.0"
```

```
bit                NA                    NA      NA     "yes"           "4.3.0"
bit64              NA                    NA      NA     "yes"           "4.3.0"
blob               NA                    NA      NA     "no"            "4.3.0"
bookdown           NA                    NA      NA     "no"            "4.3.0"
boot               NA                    NA      NA     "no"            "4.3.1"
brio               NA                    NA      NA     "yes"           "4.3.0"
broom              NA                    NA      NA     "no"            "4.3.0"
bslib              NA                    NA      NA     "no"            "4.3.0"
cachem             NA                    NA      NA     "yes"           "4.3.0"
callr              NA                    NA      NA     "no"            "4.3.0"
checkmate          NA                    NA      NA     "yes"           "4.3.0"
class              NA                    NA      NA     "yes"           "4.3.1"
cli                NA                    NA      NA     "yes"           "4.3.0"
clipr              NA                    NA      NA     "no"            "4.3.0"
cluster            NA                    NA      NA     "yes"           "4.3.1"
codetools          NA                    NA      NA     "no"            "4.3.1"
colorspace         NA                    NA      NA     "yes"           "4.3.0"
commonmark         NA                    NA      NA     "yes"           "4.3.0"
compiler           NA                    NA      NA     NA              "4.3.1"
cowplot            NA                    NA      NA     "no"            "4.3.0"
cpp11              NA                    NA      NA     "no"            "4.3.0"
crayon             NA                    NA      NA     "no"            "4.3.0"
crul               NA                    NA      NA     "no"            "4.3.0"
curl               NA                    NA      NA     "yes"           "4.3.0"
data.table         NA                    NA      NA     "yes"           "4.3.0"
datasets           NA                    NA      NA     NA              "4.3.1"
DBI                NA                    NA      NA     "no"            "4.3.0"
dbplyr             NA                    NA      NA     "no"            "4.3.0"
desc               NA                    NA      NA     "no"            "4.3.0"
diffobj            NA                    NA      NA     "yes"           "4.3.0"
digest             NA                    NA      NA     "yes"           "4.3.0"
dlookr             NA                    NA      NA     "no"            "4.3.0"
DMwR2              NA                    NA      NA     "no"            "4.3.0"
dplyr              NA                    NA      NA     "yes"           "4.3.0"
ellipsis           NA                    NA      NA     "yes"           "4.3.0"
evaluate           NA                    NA      NA     "no"            "4.3.0"
extrafont          NA                    NA      NA     "no"            "4.3.0"
extrafontdb        NA                    NA      NA     NA              "4.3.0"
fansi              NA                    NA      NA     "yes"           "4.3.0"
farver             NA                    NA      NA     "yes"           "4.3.0"
fastmap            NA                    NA      NA     "yes"           "4.3.0"
fontawesome        NA                    NA      NA     "no"            "4.3.0"
fontBitstreamVera  NA                    NA      NA     "no"            "4.3.0"
```

```
fontLiberation    NA                  NA      NA     "no"            "4.3.0"
fontquiver        NA                  NA      NA     "no"            "4.3.0"
forcats           NA                  NA      NA     "no"            "4.3.0"
foreach           NA                  NA      NA     "no"            "4.3.0"
foreign           NA                  NA      NA     "yes"           "4.3.1"
Formula           NA                  NA      NA     "no"            "4.3.0"
fs                NA                  NA      NA     "yes"           "4.3.0"
gdtools           NA                  NA      NA     "yes"           "4.3.0"
generics          NA                  NA      NA     "no"            "4.3.0"
gfonts            NA                  NA      NA     "no"            "4.3.0"
ggplot2           NA                  NA      NA     "no"            "4.3.0"
glmnet            NA                  NA      NA     "yes"           "4.3.0"
glue              NA                  NA      NA     "yes"           "4.3.0"
graphics          NA                  NA      NA     "yes"           "4.3.1"
grDevices         NA                  NA      NA     "yes"           "4.3.1"
grid              NA                  NA      NA     "yes"           "4.3.1"
gridExtra         NA                  NA      NA     "no"            "4.3.0"
gtable            NA                  NA      NA     "no"            "4.3.0"
haven             NA                  NA      NA     "yes"           "4.3.0"
highr             NA                  NA      NA     "no"            "4.3.0"
Hmisc             NA                  NA      NA     "yes"           "4.3.0"
hms               NA                  NA      NA     "no"            "4.3.0"
hrbrthemes        NA                  NA      NA     "no"            "4.3.0"
htmlTable         NA                  NA      NA     "no"            "4.3.0"
htmltools         NA                  NA      NA     "yes"           "4.3.0"
htmlwidgets       NA                  NA      NA     "no"            "4.3.0"
httpcode          NA                  NA      NA     "no"            "4.3.0"
httpuv            NA                  NA      NA     "yes"           "4.3.0"
httr              NA                  NA      NA     "no"            "4.3.0"
inum              NA                  NA      NA     "no"            "4.3.0"
isoband           NA                  NA      NA     "yes"           "4.3.0"
iterators         NA                  NA      NA     "no"            "4.3.0"
jomo              NA                  NA      NA     "yes"           "4.3.0"
jquerylib         NA                  NA      NA     "no"            "4.3.0"
jsonlite          NA                  NA      NA     "yes"           "4.3.0"
kableExtra        NA                  NA      NA     "no"            "4.3.0"
KernSmooth        NA                  NA      NA     "yes"           "4.3.1"
knitr             NA                  NA      NA     "no"            "4.3.0"
labeling          NA                  NA      NA     "no"            "4.3.0"
later             NA                  NA      NA     "yes"           "4.3.0"
lattice           NA                  NA      NA     "yes"           "4.3.1"
libcoin           NA                  NA      NA     "yes"           "4.3.0"
lifecycle         NA                  NA      NA     "no"            "4.3.0"
```

```
lme4              NA                  NA      NA     "yes"           "4.3.0"
magrittr          NA                  NA      NA     "yes"           "4.3.0"
markdown          NA                  NA      NA     "no"            "4.3.0"
MASS              NA                  NA      NA     "yes"           "4.3.1"
Matrix            NA                  NA      NA     "yes"           "4.3.1"
memoise           NA                  NA      NA     "no"            "4.3.0"
methods           NA                  NA      NA     "yes"           "4.3.1"
mgcv              NA                  NA      NA     "yes"           "4.3.1"
mice              NA                  NA      NA     "yes"           "4.3.0"
mime              NA                  NA      NA     "yes"           "4.3.0"
minqa             NA                  NA      NA     "yes"           "4.3.0"
mitml             NA                  NA      NA     "no"            "4.3.0"
munsell           NA                  NA      NA     "no"            "4.3.0"
mvtnorm           NA                  NA      NA     "yes"           "4.3.0"
nlme              NA                  NA      NA     "yes"           "4.3.1"
nloptr            NA                  NA      NA     "yes"           "4.3.0"
nnet              NA                  NA      NA     "yes"           "4.3.1"
numDeriv          NA                  NA      NA     "no"            "4.3.0"
openssl           NA                  NA      NA     "yes"           "4.3.0"
ordinal           NA                  NA      NA     "yes"           "4.3.0"
pacman            NA                  NA      NA     "no"            "4.3.0"
pagedown          NA                  NA      NA     "no"            "4.3.0"
palmerpenguins    NA                  NA      NA     "no"            "4.3.0"
pan               NA                  NA      NA     "yes"           "4.3.0"
parallel          NA                  NA      NA     "yes"           "4.3.1"
partykit          NA                  NA      NA     "yes"           "4.3.0"
pillar            NA                  NA      NA     "no"            "4.3.0"
pkgconfig         NA                  NA      NA     "no"            "4.3.0"
pkgload           NA                  NA      NA     "no"            "4.3.0"
plyr              NA                  NA      NA     "yes"           "4.3.0"
praise            NA                  NA      NA     "no"            "4.3.0"
prettyunits       NA                  NA      NA     "no"            "4.3.0"
processx          NA                  NA      NA     "yes"           "4.3.0"
progress          NA                  NA      NA     "no"            "4.3.0"
promises          NA                  NA      NA     "yes"           "4.3.0"
ps                NA                  NA      NA     "yes"           "4.3.0"
purrr             NA                  NA      NA     "yes"           "4.3.0"
quantmod          NA                  NA      NA     "no"            "4.3.0"
R6                NA                  NA      NA     "no"            "4.3.0"
rappdirs          NA                  NA      NA     "yes"           "4.3.0"
RColorBrewer      NA                  NA      NA     "no"            "4.3.0"
Rcpp              NA                  NA      NA     "yes"           "4.3.0"
RcppEigen         NA                  NA      NA     "yes"           "4.3.0"
```

reactable	NA	NA	NA	"no"	"4.3.0"
reactR	NA	NA	NA	"no"	"4.3.0"
readr	NA	NA	NA	"yes"	"4.3.0"
rematch2	NA	NA	NA	"no"	"4.3.0"
remotes	NA	NA	NA	"no"	"4.3.0"
reshape2	NA	NA	NA	"yes"	"4.3.0"
rlang	NA	NA	NA	"yes"	"4.3.0"
rmarkdown	NA	NA	NA	"no"	"4.3.0"
rpart	NA	NA	NA	"yes"	"4.3.1"
rprojroot	NA	NA	NA	"no"	"4.3.0"
rstudioapi	NA	NA	NA	"no"	"4.3.0"
Rttf2pt1	NA	NA	NA	"yes"	"4.3.0"
rvest	NA	NA	NA	"no"	"4.3.0"
sass	NA	NA	NA	"yes"	"4.3.0"
scales	NA	NA	NA	"no"	"4.3.0"
selectr	NA	NA	NA	"no"	"4.3.0"
servr	NA	NA	NA	"no"	"4.3.0"
shape	NA	NA	NA	"no"	"4.3.0"
shiny	NA	NA	NA	"no"	"4.3.0"
showtext	NA	NA	NA	"yes"	"4.3.0"
showtextdb	NA	NA	NA	"no"	"4.3.0"
sourcetools	NA	NA	NA	"yes"	"4.3.0"
spatial	NA	NA	NA	"yes"	"4.3.1"
splines	NA	NA	NA	"yes"	"4.3.1"
stats	NA	NA	NA	"yes"	"4.3.1"
stats4	NA	NA	NA	NA	"4.3.1"
stringi	NA	NA	NA	"yes"	"4.3.0"
stringr	NA	NA	NA	"no"	"4.3.0"
survival	NA	NA	NA	"yes"	"4.3.1"
svglite	NA	NA	NA	"yes"	"4.3.0"
sys	NA	NA	NA	"yes"	"4.3.0"
sysfonts	NA	NA	NA	"yes"	"4.3.0"
systemfonts	NA	NA	NA	"yes"	"4.3.0"
tcltk	NA	NA	NA	"yes"	"4.3.1"
testthat	NA	NA	NA	"yes"	"4.3.0"
tibble	NA	NA	NA	"yes"	"4.3.0"
tidyr	NA	NA	NA	"yes"	"4.3.0"
tidyselect	NA	NA	NA	"no"	"4.3.0"
tinytex	NA	NA	NA	"no"	"4.3.0"
tools	NA	NA	NA	"yes"	"4.3.1"
triebeard	NA	NA	NA	"yes"	"4.3.0"
TTR	NA	NA	NA	"yes"	"4.3.0"
tzdb	NA	NA	NA	"yes"	"4.3.0"

```
ucminf            NA                    NA      NA     "yes"            "4.3.0"
urltools          NA                    NA      NA     "yes"            "4.3.0"
utf8              NA                    NA      NA     "yes"            "4.3.0"
utils             NA                    NA      NA     "yes"            "4.3.1"
vctrs             NA                    NA      NA     "yes"            "4.3.0"
viridis           NA                    NA      NA     "no"             "4.3.0"
viridisLite       NA                    NA      NA     "no"             "4.3.0"
vroom             NA                    NA      NA     "yes"            "4.3.0"
waldo             NA                    NA      NA     "no"             "4.3.0"
webshot           NA                    NA      NA     "no"             "4.3.0"
websocket         NA                    NA      NA     "yes"            "4.3.0"
withr             NA                    NA      NA     "no"             "4.3.0"
xfun              NA                    NA      NA     "yes"            "4.3.0"
xml2              NA                    NA      NA     "yes"            "4.3.0"
xtable            NA                    NA      NA     "no"             "4.3.0"
xts               NA                    NA      NA     "yes"            "4.3.0"
yaml              NA                    NA      NA     "yes"            "4.3.0"
zoo               NA                    NA      NA     "yes"            "4.3.0"
```

- Find out if your installed packages have a newer version on CRAN:

```
#old.packages()
```

- Update all your installed packages to the newest version:

```
#update.packages()
```

- Update without confirmation message for each package

```
#update.packages(ask = FALSE)
```

- Find out the namespace/package a function belongs in your installed packages, just type the function name

```
mean
```

```
function (x, ...)
UseMethod("mean")
<bytecode: 0x12f951560>
<environment: namespace:base>
```

- Find help on a function in an installed package, say mean()

```
help(mean)
```

- When you want to see if a package you need to use has already been made, search for it using some keywords such as:

```
RSiteSearch('machine learning')
```

```
A search query has been submitted to https://search.r-project.org
The results page should open in your browser shortly
```

- All objects are saved in .RData file in the current working directory for you to load in the future.

Project and Session Management

```
#save(my.function, mydataset, file="path_to_mysession.RData")
#load("path_to_mysession.RData")
```

Save all objects

```
save.image()
```

- Run getwd() and setwd() in RStudio Console to show the current working directory and to set working directory respectively.

```
getwd()
```

```
[1] "/Users/VKD/Downloads"
```

```
#setwd("/Users/VKD/Downloads") # setwd using what you get from getwd()

getwd()
```

```
[1] "/Users/VKD/Downloads"
```

R OBJECTS AND VARIABLES:

To give a value to a variable:

```
vat <- 3.14
```

To see what value the variable holds just type in the variable name:

```
vat
```

```
[1] 3.14
```

Use () to enclose a statement to have the returned values print directly:

```
(vat <- 3.14)
```

```
[1] 3.14
```

```
x <- 5
y <- vat * x
y
```

```
[1] 15.7
```

```
z <-(y/2)^2
y
```

```
[1] 15.7
```

```
z
```

```
[1] 61.6225
```

All variables stay alive until you delete it or when your exit R without saving them to list variables currently alive: ls() or objects()

```
ls()
```

```
[1] "algae"           "algae.sols"      "has_annotations" "test.algae"
[5] "vat"             "x"               "y"               "z"
```

```
objects()
```

```
[1] "algae"           "algae.sols"      "has_annotations" "test.algae"
[5] "vat"             "x"               "y"               "z"
```

Remove a variable to free memory space:

```
rm(vat)
```

R FUNCTIONS:

-To find the maximum value:

```
max(4, 5, 6, 12, -4)
```

```
[1] 12
```

-To find the mean value:

```
mean(4, 5, 6, 12, -4)
```

```
[1] 4
```

```
max(sample(1:100, 30))
```

```
[1] 99
```

```
mean(sample(1:100, 30))
```

```
[1] 53.46667
```

- the seed determines the starting point used in generating a sequence of pseudo random numbers #set.seed() has global scope, meaning it affects all random number generators used/called in your program.

```r
set.seed(1)

#Generate 1 number from Normal distribution
rnorm(1)
```

```
[1] -0.6264538
```

```r
rnorm(1)
```

```
[1] 0.1836433
```

```r
set.seed(2)
rnorm(1)
```

```
[1] -0.8969145
```

```r
rnorm(1)
```

```
[1] 0.1848492
```

To create a new function, se (standard error of means), first test if se exists in our current environment.

```r
exists("se")
```

```
[1] FALSE
```

No object namedse exists, now create the function that computes the standard error of a sample:

```r
se <- function(x){
  variance <- var(x)
  n <-length(x)
  return (sqrt(variance/n))
}
```

Object se has been created:

```
exists("se")
```

```
[1] TRUE
```

- convMeters will convert meters to inches, feet, yards, and miles

```
convMeters <- function (x, to="inch"){
  factor = switch(to, inch=39.3701, foot=3.28084, yard=1.09361, mile=0.000621371, NA)
  if(is.na(factor)) stop ("unknown target unit")
  else return (x*factor)
}
convMeters(23, "foot")
```

```
[1] 75.45932
```

If no argument to is provided, the default value is inch.

```
convMeters(40)
```

```
[1] 1574.804
```

Arguments for the function can be supplied in the order as in the function signature:

```
convMeters(56.2, "yard")
```

```
[1] 61.46088
```

```
convMeters(to="yard", 56.2)
```

```
[1] 61.46088
```

FACTORS:

To create a factor, use factor(). Factors are represented internally as numeric vectors.

This factor has two levels, f and m.

```
g <-c('f', 'm', 'f', 'f', 'f', 'm', 'm', 'f')
g <- factor(g)
```

More compact way to creating a factor with known levels, f and m:

```
other.g <-factor(c('m', 'm', 'm', 'm'), levels= c('f', 'm'))
other.g
```

```
[1] m m m m
Levels: f m
```

```
other.g <-factor(c('m', 'm', 'm', 'm'))
other.g
```

```
[1] m m m m
Levels: m
```

Factors are extremely useful for nominal values. Use factor to illustrate the concept of marginal frequencies or marginal distributions and `table()` function:

```
g <- factor(c('f', 'm', 'f', 'f', 'f', 'm', 'm', 'f'))
table(g)
```

```
g
f m
5 3
```

Add an age factor to the table (table can have more than two factors):

```
##a <- factor(c('adult', 'juvenile','adult', 'juvenile','adult', 'juvenile','juvenile', 'j
##table(a, g)
```

R assumes the values at the same index in the two factors are associated with the same entity.
In our dataset, we have 3 female adult, 2 female juvenile, and 3 male juvenile.

What if the a factor is not the same length as g factor?

```
#a <- factor(c('adult', 'juvenile','adult', 'juvenile','adult', 'juvenile','juvenile'))
#table(a, g)
```

Bring the good `a` back and create a new table with factor `g`

```
a <- factor(c('adult', 'juvenile','adult', 'juvenile','adult', 'juvenile','juvenile', 'juv
t <- table(a, g)
t
```

```
          g
a          f m
  adult    3 0
  juvenile 2 3
```

Find marginal frequencies for a factor:

```
margin.table(t, 1)
```

```
a
   adult juvenile
       3        5
```

```
margin.table(t, 2)
```

```
g
f m
5 3
```

We can also find relative frequencies (proportions) with respect to each margin and the overall:

```
t
```

```
          g
a          f m
  adult    3 0
  juvenile 2 3
```

```
prop.table(t, 1) #use the margin generated for the 1st factor a
```

```
          g
a            f   m
  adult    1.0 0.0
  juvenile 0.4 0.6
```

Adults are all female, and among the juveniles, 40% are female and 60% are male.

```
prop.table(t, 2)
```

```
          g
a            f   m
  adult    0.6 0.0
  juvenile 0.4 1.0
```

```
prop.table(t) #overall
```

```
          g
a              f     m
  adult    0.375 0.000
  juvenile 0.250 0.375
```

```
prop.table(t) * 100 #RESULTS IN PERCENTAGE
```

```
          g
a             f    m
  adult    37.5  0.0
  juvenile 25.0 37.5
```

R Data Structures

- VECTORS:

Create a vector:

```
v <- c(2, 5, 3, 4)
length(v)
```

```
[1] 4
```

Data type of elements in v:

```
mode(v)
```

```
[1] "numeric"
```

If you mix strings and numbers:

```
v <- c(2, 5, 3, 4, 'me')
mode(v)
```

```
[1] "character"
```

```
v
```

```
[1] "2"  "5"  "3"  "4"  "me"
```

All vectors can contain a special value `NA`, often used to represent a missing value:

```
v <- c(2, 5, 3, 4, NA)
mode(v)
```

```
[1] "numeric"
```

```
v
```

```
[1]  2  5  3  4 NA
```

A boolean vector (`TRUE`, `FALSE`)

```
b <- c(TRUE, FALSE, NA, TRUE)
mode(b)
```

```
[1] "logical"
```

```
b
```

```
[1]  TRUE FALSE    NA  TRUE
```

Elements in vectors are indexed starting with 1:

```
b[3]
```

```
[1] NA
```

To update a value at a specific index:

```
b[3] <- TRUE
b
```

```
[1]  TRUE FALSE  TRUE  TRUE
```

Vectors are elastic; you can add values to any index position:

```
b[10] <- FALSE
b
```

```
 [1]  TRUE FALSE  TRUE  TRUE    NA    NA    NA    NA    NA FALSE
```

Create an empty vector:

```
e <-vector()
mode(e)
```

```
[1] "logical"
```

```
e <- c()
mode(e)
```

```
[1] "NULL"
```

```
length(e)
```

```
[1] 0
```

Use a vector elements to construct another vector:

```
b2 <-c(b[1], b[3], b[5])
b2
```

```
[1] TRUE TRUE   NA
```

Find the square root of all elements in v:

```
sqrt(v)
```

```
[1] 1.414214 2.236068 1.732051 2.000000       NA
```

Addition:

```
v1 <- c(3, 6, 9)
v2 <- c(1, 4, 8)
v1+v2
```

```
[1]  4 10 17
```

Dot product:

```
v1*v2
```

```
[1]  3 24 72
```

Subtraction

```
v1-v2
```

```
[1] 2 2 1
```

Division

```
v1/v2
```

```
[1] 3.000 1.500 1.125
```

Recycling Rule:

```
v3 <- c(1, 4)
v1+v3#it makes v3 [1, 4, 1]
```

```
Warning in v1 + v3: longer object length is not a multiple of shorter object
length
```

```
[1]  4 10 10
```

```
2*v1
```

```
[1]  6 12 18
```

- Vector Summary Use vector to illustrate "for" loop:

```
mysum <- function (x){
  sum <- 0
  for(i in 1:length(x)){
    sum <- sum + x[i]
  }
  return (sum)
}

(mysum (c(1, 2, 3)))
```

```
[1] 6
```

- EASY WAYS TO GENERATE VECTORS:

```
(x <-1:10)
```

```
 [1]  1  2  3  4  5  6  7  8  9 10
```

```
(x <-10:1)
```

```
 [1] 10  9  8  7  6  5  4  3  2  1
```

```
10:15-1
```

```
[1]  9 10 11 12 13 14
```

```
10:(15-1)
```

```
[1] 10 11 12 13 14
```

Use seq() to generate sequence with real numbers:

```
(seq(from=1, to=5, length=4))
```

```
[1] 1.000000 2.333333 3.666667 5.000000
```

```
(seq(length=10, from=-2, by=0.5))
```

```
 [1] -2.0 -1.5 -1.0 -0.5  0.0  0.5  1.0  1.5  2.0  2.5
```

Use rep(x,n) repeat x n times:

```
(rep(5, 10))
```

```
 [1] 5 5 5 5 5 5 5 5 5 5
```

```
(rep("hi", 3))
```

```
[1] "hi" "hi" "hi"
```

```
(rep(1:2, 3))
```

```
[1] 1 2 1 2 1 2
```

```
  (rep(TRUE:FALSE, 3))
```

```
[1] 1 0 1 0 1 0
```

```
  (rep(1:2, each=3))
```

```
[1] 1 1 1 2 2 2
```

gl() is for generating factor levels:

```
  gl(3, 5)
```

```
 [1] 1 1 1 1 1 2 2 2 2 2 3 3 3 3 3
Levels: 1 2 3
```

```
  gl(2, 5, labels= c('female', 'male'))#two levels, each level repeat 5 times
```

```
 [1] female female female female female male   male   male   male   male
Levels: female male
```

```
  #first argument 2 says two levels.
  #second argument 1 says repeat once
  #third argment 20 says generate 20 values
  gl(2, 1, 20, labels=c('female', 'male'))#10 alternating female and male pairs, a total of
```

```
 [1] female male   female male   female male   female male   female male
[11] female male   female male   female male   female male   female male
Levels: female male
```

Use factor to convert number sequence to factor level labels. This is very useful for labeling a dataset:

```
  n <- rep(1:2, each=3)
  (n <- factor(n,
               levels = c(1, 2),
```

```
              labels = c('female','male')
              ))
```

```
[1] female female female male   male   male
Levels: female male
```

```
  n
```

```
[1] female female female male   male   male
Levels: female male
```

Generate 10 values following a normal distribution with mean=10 and standard deviation=3:

```
  (rnorm(10, mean=10, sd=3))
```

```
 [1] 14.763536  6.608873  9.759245 10.397261 12.123864  9.280906 15.953422
 [8]  9.583639 11.252952 12.945258
```

```
  (rt(10, df=5)) #10 values following a Student T distribution with degree of freedom of 5
```

```
 [1] -0.69423122 -1.90338399  0.02947754  0.27787640 -0.85885978  2.18155848
 [7] -2.34536097 -0.52103705  0.25674735  0.25832186
```

EXERCISE:

(1) Generate a random sample of `normally distributed` data of `size 100`, with a `mean of` 20 and `standard deviation` 4

(2) Compute the standard error of means of the dataset.

```
set.seed(42)

sample_data <- rnorm(n = 100, mean = 20, sd = 4)

# Compute the standard error of means
standard_error <- sd(sample_data) / sqrt(length(sample_data))
```

```
print(paste("Standard Error of Means:", standard_error))
```

```
[1] "Standard Error of Means: 0.416542784626013"
```

Use boolean operators:

```
x <- c(0, -3, 4, -1, 45, 90, -5)
#select all elements that is greater than 0
(gtzero <- x[x>0])
```

```
[1]  4 45 90
```

Use | (or) and & (and) operators:

```
x <- c(0, -3, 4, -1, 45, 90, -5)
(x[x<=-2 | x>5])
```

```
[1] -3 45 90 -5
```

```
(x[x>40 & x<100])
```

```
[1] 45 90
```

```
(x[x>40 & x<100])
```

```
[1] 45 90
```

Use a vector index:

```
x <- c(0, -3, 4, -1, 45, 90, -5)
(x[c(4, 6)])#select the 4th and 6th elements in the vector
```

```
[1] -1 90
```

```
(y<-c(4,6)) #same as above
```

```
[1] 4 6
```

```
(x[y])
```

```
[1] -1 90
```

```
(x[1:3]) #select the 1st to the 3rd elements in the vector
```

```
[1]  0 -3  4
```

Use negative index to exclude elements:

```
x <- c(0, -3, 4, -1, 45, 90, -5)
(x[-1]) #select all but the first element
```

```
[1] -3  4 -1 45 90 -5
```

```
(x[-c(4, 6)])
```

```
[1]  0 -3  4 45 -5
```

```
(x[-(1:3)])
```

```
[1] -1 45 90 -5
```

NAMED ELEMENTS:

Assign names to vector elements:

```
x <- c(0, -3, 4, -1, 45, 90, -5)
names(x) <- c('s1', 's2', 's3', 's4', 's5', 's6', 's7')
x
```

```
s1 s2 s3 s4 s5 s6 s7
 0 -3  4 -1 45 90 -5
```

```
(pH <- c(area1=4.5, area2=5.7, area3=9.8, mud=7.2))
```

```
area1 area2 area3   mud
  4.5   5.7   9.8   7.2
```

Use individual names to reference/select elements:

```
pH['mud']
```

```
mud
7.2
```

```
pH[c('area1', 'mud')]
```

```
area1   mud
  4.5   7.2
```

…but can not use directly element names to exclude or select a range of elements:

```
#x[-s1] #results in error
```

Error in eval(expr, envir, enclos): object ‘s1’ not found

```
#x[-"s1"] #results in error
```

```
#x[s1:s7] #results in error
```

```
#x[c('s1':'s7')] #results in error
```

Empty index means to select all:

```
pH[]
```

```
area1 area2 area3   mud
  4.5   5.7   9.8   7.2
```

```
  pH
```

```
area1 area2 area3   mud
  4.5   5.7   9.8   7.2
```

Use this method to reset a vector to 0:

```
  pH[] <- 0
  pH
```

```
area1 area2 area3   mud
    0     0     0     0
```

```
  pH<- 0
  pH
```

```
[1] 0
```

- Matrices and arrays:

To create a matrix:

```
  m <- c(45, 23, 66, 77, 33, 44, 56, 12, 78, 23)
  is.vector(m)
```

```
[1] TRUE
```

```
  is.matrix(m)
```

```
[1] FALSE
```

```
  is.array(m)
```

```
[1] FALSE
```

```
#then 'organize' the vector as a matrix
dim(m) <-c(2, 5)#make the vector a 2 by 5 matrix, 2x5 must = lenght of the vector
m
```

```
     [,1] [,2] [,3] [,4] [,5]
[1,]   45   66   33   56   78
[2,]   23   77   44   12   23
```

```
is.vector(m)
```

```
[1] FALSE
```

```
is.matrix(m)
```

```
[1] TRUE
```

```
is.array(m)
```

```
[1] TRUE
```

By default, the elements are put in matrix by columns. Use `byrow=TRUE` to do it the other way:

```
(m <- matrix(c(45, 23, 66, 77, 33, 44, 56, 12, 78, 23), 2, 5, byrow = TRUE))
```

```
     [,1] [,2] [,3] [,4] [,5]
[1,]   45   23   66   77   33
[2,]   44   56   12   78   23
```

EXERCISE:

Create a matrix with two columns:

First columns hold age data for a group of students `11, 11, 12, 13, 14, 9, 8`, and second columns hold grades `5, 5, 6, 7, 8, 4, 3`.

```r
test <-matrix(c(11, 11, 12, 13, 14, 9, 8, 5, 5, 6, 7, 8, 4, 3), 7, 2)
test
```

```
     [,1] [,2]
[1,]   11    5
[2,]   11    5
[3,]   12    6
[4,]   13    7
[5,]   14    8
[6,]    9    4
[7,]    8    3
```

Access matrix elements using position indexes (again, index starting from 1):

```r
m <- c(45, 23, 66, 77, 33, 44, 56, 12, 78, 23)
#then 'organize' the vector as a matrix
dim(m) <- c(2, 5)#make the vector a 2 by 5 matrix, 2x5 must = lenght of the vector
m
```

```
     [,1] [,2] [,3] [,4] [,5]
[1,]   45   66   33   56   78
[2,]   23   77   44   12   23
```

The result is a value (a value is a vector), a vector, or a matrix:

```r
(s<- m[2, 1]) # select one value
```

```
[1] 23
```

```r
(m<- m [c(1,2), -c(3, 5)]) #select 1st row and 1st, 2nd, and 4th columns: result is a vect
```

```
     [,1] [,2] [,3]
[1,]   45   66   56
[2,]   23   77   12
```

```r
(m [1, ]) #select complete row or column: 1st row, result is a vector
```

```
[1] 45 66 56
```

```
  (v<-m [, 1]) # 1st column, result is a vector
```

```
[1] 45 23
```

```
  is.vector(m)
```

```
[1] FALSE
```

```
  is.matrix(m)
```

```
[1] TRUE
```

```
  is.vector(s)
```

```
[1] TRUE
```

```
  is.vector(v)
```

```
[1] TRUE
```

```
  is.matrix(v)
```

```
[1] FALSE
```

Use drop=FALSE to keep the results as a matrix (not vectors like shown above)

```
  m <- matrix(c(45, 23, 66, 77, 33, 44, 56, 12, 78, 23), 2, 5)
  (m<-m [, 2, drop = FALSE])
```

```
     [,1]
[1,]   66
[2,]   77
```

```
is.matrix(m)
```

```
[1] TRUE
```

```
is.vector(m)
```

```
[1] FALSE
```

cbind() and rbind() join together two or more vectors or matrices, by column, or by row, respectively:

```
cbind (c(1,2,3), c(4, 5, 6))
```

```
     [,1] [,2]
[1,]    1    4
[2,]    2    5
[3,]    3    6
```

```
rbind (c(1,2,3), c(4, 5, 6))
```

```
     [,1] [,2] [,3]
[1,]    1    2    3
[2,]    4    5    6
```

```
m <- matrix(c(45, 23, 66, 77, 33, 44, 56, 12, 78, 23), 2, 5)
(a <- rbind (c(1,2,3,4,5), m))
```

```
     [,1] [,2] [,3] [,4] [,5]
[1,]    1    2    3    4    5
[2,]   45   66   33   56   78
[3,]   23   77   44   12   23
```

```
is.array(a)
```

```
[1] TRUE
```

```
is.matrix(a)
```

```
[1] TRUE
```

EXERCISE:

What will m1-m4 look like?

```
 #m1 <- matrix(rep(10, 9), 3, 3) m2 <- cbind (c(1,2,3), c(4, 5, 6)) m3 <- cbind (m1[,1], m
```

NAMED ROWS AND COLUMNS:

```
sales <- matrix(c(10, 30, 40, 50, 43, 56, 21, 30), 2, 4, byrow=TRUE)
colnames(sales) <- c('1qrt', '2qrt', '3qrt', '4qrt')
rownames(sales) <- c('store1', 'store2')
sales
```

```
       1qrt 2qrt 3qrt 4qrt
store1   10   30   40   50
store2   43   56   21   30
```

EXERCISE:

Find store1 1qrt sale. 2. List store2's 1st and 4th quarter sales:

```
sales['store1', '1qrt']
```

```
[1] 10
```

```
sales['store2', c('1qrt', '4qrt')]
```

```
1qrt 4qrt
  43   30
```

- ARRAYS: 3D-ARRAYS

```
a <- array(1:48, dim= c(4, 3, 2))
a
```

```
, , 1

     [,1] [,2] [,3]
[1,]    1    5    9
[2,]    2    6   10
[3,]    3    7   11
[4,]    4    8   12

, , 2

     [,1] [,2] [,3]
[1,]   13   17   21
[2,]   14   18   22
[3,]   15   19   23
[4,]   16   20   24
```

Select array elements using indexes, results may be a value, a vector, a matrix or an array, depending on the use of drop=FALSE:

```
a [1, 3, 2]
```

```
[1] 21
```

```
a [1, , 2]
```

```
[1] 13 17 21
```

```
a [1, , 2, drop=FALSE]
```

```
, , 1

     [,1] [,2] [,3]
[1,]   13   17   21
```

```
a [4, 3, ]
```

```
[1] 12 24
```

```
  a [c(2, 3), , -2]
```

```
     [,1] [,2] [,3]
[1,]    2    6   10
[2,]    3    7   11
```

Assign names to dimensions of an array.

```
dimnames(a)[[1]] <-c("1qrt", "2qrt", "3qrt", "4qrt")
dimnames(a)[[2]] <-c("store1", "store2", "store3")
dimnames(a)[[3]] <-c("2017", "2018")
a
```

```
, , 2017

     store1 store2 store3
1qrt      1      5      9
2qrt      2      6     10
3qrt      3      7     11
4qrt      4      8     12

, , 2018

     store1 store2 store3
1qrt     13     17     21
2qrt     14     18     22
3qrt     15     19     23
4qrt     16     20     24
```

Alternatively, use list() to specify names:

```
ar <- array(data     = 1:27,
            dim      = c(3, 3, 3),
            dimnames = list(c("a", "b", "c"),
ar
```

```
, , g

  d e f
a 1 4 7
```

```
b 2 5 8
c 3 6 9

, , h

   d  e  f
a 10 13 16
b 11 14 17
c 12 15 18

, , i

   d  e  f
a 19 22 25
b 20 23 26
c 21 24 27
```

SPLIT ARRAY INTO MATRICES:

```
matrix1 <- ar[,,g]
```

```
matrix1 <- ar[,,'g']
matrix1
```

```
  d e f
a 1 4 7
b 2 5 8
c 3 6 9
```

```
matrix2 <- ar[,,'h']
matrix2
```

```
   d  e  f
a 10 13 16
b 11 14 17
c 12 15 18
```

```
sum <-matrix1 + matrix2
sum
```

```
   d  e  f
a 11 17 23
b 13 19 25
c 15 21 27
```

```
matrix1*3
```

```
  d  e  f
a 3 12 21
b 6 15 24
c 9 18 27
```

A matrix is just a long vector organized into dimensions, note the recycling rules apply:

```
matrix1
```

```
  d e f
a 1 4 7
b 2 5 8
c 3 6 9
```

```
matrix1*c(2, 3)
```

```
Warning in matrix1 * c(2, 3): longer object length is not a multiple of shorter
object length
```

```
  d  e  f
a 2 12 14
b 6 10 24
c 6 18 18
```

```
matrix1*c(2,3,2,3,2,3,2,3,2)
```

```
  d  e  f
a 2 12 14
b 6 10 24
c 6 18 18
```

```
matrix1*c(1, 2, 3)
```

```
  d  e  f
a 1  4  7
b 4 10 16
c 9 18 27
```

```
matrix1/c(1, 2, 3)
```

```
  d   e f
a 1 4.0 7
b 1 2.5 4
c 1 2.0 3
```

```
matrix1/c(1, 2, 3, 1, 2, 3, 1, 2, 3)
```

```
  d   e f
a 1 4.0 7
b 1 2.5 4
c 1 2.0 3
```

- LISTS:

```
mylist <- list(stud.id=34453,
               stud.name="John",
               stud.marks= c(13, 3, 12, 15, 19)
               )

mylist$stud.id
```

```
[1] 34453
```

```
mylist[1]
```

```
$stud.id
[1] 34453
```

```
  mylist[[1]]
```

```
[1] 34453
```

```
  mylist["stud.id"]
```

```
$stud.id
[1] 34453
```

```
  handle <- "stud.id"
  mylist[handle]
```

```
$stud.id
[1] 34453
```

```
  mylist[["stud.id"]]
```

```
[1] 34453
```

INTERACT WITH $

```
  mylist <- list(stud.id=34453,
                 stud.name="John",
                 stud.marks= c(13, 3, 12, 15, 19)
                 )
  mylist$stud.marks
```

```
[1] 13  3 12 15 19
```

```
  mylist$stud.marks[2]
```

```
[1] 3
```

Change names:

```
  names(mylist)
```

```
[1] "stud.id"    "stud.name"  "stud.marks"
```

```
  names(mylist) <- c('id','name','marks')

  names(mylist)
```

```
[1] "id"    "name"  "marks"
```

```
  mylist
```

```
$id
[1] 34453

$name
[1] "John"

$marks
[1] 13  3 12 15 19
```

```
  mylist$parents.names <- c('Ana', "Mike")
  mylist
```

```
$id
[1] 34453

$name
[1] "John"

$marks
[1] 13  3 12 15 19

$parents.names
[1] "Ana"  "Mike"
```

Use c() to concatenate two lists:

```
newlist <- list(age=19, sex="male");
expandedlist <-c(mylist, newlist)
expandedlist
```

```
$id
[1] 34453

$name
[1] "John"

$marks
[1] 13  3 12 15 19

$parents.names
[1] "Ana"  "Mike"

$age
[1] 19

$sex
[1] "male"
```

```
length(expandedlist)
```

```
[1] 6
```

REMOVE LIST COMPONENTS USING NEGATIVE INDEX OR NULL:

```
expandedlist <- expandedlist[-5]
expandedlist <- expandedlist[c(-1,-5)]
expandedlist$parents.names <- NULL
expandedlist[['marks']] <- NULL
```

unlist() coerces a list to a vector:

```
mylist
```

```
$id
[1] 34453
```

```
$name
[1] "John"

$marks
[1] 13  3 12 15 19

$parents.names
[1] "Ana"  "Mike"
```

```
unlist(mylist)
```

```
          id           name         marks1         marks2         marks3
     "34453"         "John"           "13"            "3"           "12"
      marks4         marks5 parents.names1 parents.names2
        "15"           "19"          "Ana"         "Mike"
```

```
mode(mylist)
```

```
[1] "list"
```

```
mode(unlist(mylist))
```

```
[1] "character"
```

```
is.vector(unlist(mylist)) #atomic list with names
```

```
[1] TRUE
```

```
is.list(mylist)
```

```
[1] TRUE
```

- DATA FRAMES:

Create a dataframe

```
my.dataframe <- data.frame(site=c('A', 'B', 'A','A', 'B'),
                           season=c('winter', 'summer', 'summer', 'spring', 'fall'), ph =
my.dataframe
```

```
  site season  ph
1    A winter 7.4
2    B summer 6.3
3    A summer 8.6
4    A spring 7.2
5    B   fall 8.9
```

```
my.dataframe[['site']]
```

```
[1] "A" "B" "A" "A" "B"
```

```
my.dataframe['site']
```

```
  site
1    A
2    B
3    A
4    A
5    B
```

```
my.dataframe[my.dataframe$ph>7, ]
```

```
  site season  ph
1    A winter 7.4
3    A summer 8.6
4    A spring 7.2
5    B   fall 8.9
```

```
my.dataframe[my.dataframe$ph>7, 'site']
```

```
[1] "A" "A" "A" "B"
```

```
my.dataframe[my.dataframe$ph>7, c('site', 'ph')]
```

```
  site  ph
1    A 7.4
3    A 8.6
4    A 7.2
5    B 8.9
```

USE SUBSET TO QUERY A DATAFRAME:

```
subset(my.dataframe, ph>7)
```

```
  site season  ph
1    A winter 7.4
3    A summer 8.6
4    A spring 7.2
5    B   fall 8.9
```

```
subset(my.dataframe, ph>7, c("site", "ph"))
```

```
  site  ph
1    A 7.4
3    A 8.6
4    A 7.2
5    B 8.9
```

```
subset(my.dataframe[1:2,], ph>7, c(site, ph))
```

```
  site  ph
1    A 7.4
```

To change values in data frame - add 1 to summer ph:

```
my.dataframe[my.dataframe$season=='summer', 'ph'] <- my.dataframe[my.dataframe$season=='su
                                                                  my.dataframe[my.datafram
```

```
[1] 7.3 9.6
```

```
my.dataframe[my.dataframe$season=='summer' & my.dataframe$ph>8, 'ph'] <- my.dataframe[my.d

my.dataframe[my.dataframe$season=='summer', 'ph']
```

```
[1]  7.3 10.6
```

ADD A COLUMN:

```
my.dataframe$NO3 <- c(234.5, 123.4, 456.7, 567.8, 789.0)
my.dataframe
```

```
  site season   ph   NO3
1    A winter  7.4 234.5
2    B summer  7.3 123.4
3    A summer 10.6 456.7
4    A spring  7.2 567.8
5    B   fall  8.9 789.0
```

REMOVE A COLUMN:

```
#my.dataframe$NO3<-NULL
my.dataframe <- my.dataframe[, -4]
my.dataframe
```

```
  site season   ph
1    A winter  7.4
2    B summer  7.3
3    A summer 10.6
4    A spring  7.2
5    B   fall  8.9
```

Check the structure of a data frame:

```
str(my.dataframe)
```

```
'data.frame':   5 obs. of  3 variables:
 $ site  : chr  "A" "B" "A" "A" ...
 $ season: chr  "winter" "summer" "summer" "spring" ...
 $ ph    : num  7.4 7.3 10.6 7.2 8.9
```

```
nrow(my.dataframe)
```

```
[1] 5
```

```
ncol(my.dataframe)
```

```
[1] 3
```

```
dim(my.dataframe)
```

```
[1] 5 3
```

Edit a data frame:

```
 #edit(my.dataframe) #this brings up a data editor
```

```
#View(my.dataframe) #this brings up a uneditable tab that display the data for you to view
```

Update names of the columns:

```
names(my.dataframe)
```

```
[1] "site"   "season" "ph"
```

```
names(my.dataframe) <- c('area', 'season', 'P.h.')
my.dataframe
```

```
  area season P.h.
1    A winter  7.4
2    B summer  7.3
3    A summer 10.6
4    A spring  7.2
5    B   fall  8.9
```

```
  names(my.dataframe)[3] <- 'ph'
  my.dataframe
```

```
  area season   ph
1    A winter  7.4
2    B summer  7.3
3    A summer 10.6
4    A spring  7.2
5    B   fall  8.9
```

- TIBBLES:

Tibbles are similar to data frame, but they are more convenient than data frame.

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

CREATE A TIBBLE:

```
  my.tibble <- tibble(TempCels = sample(-10:40, size=100, replace=TRUE),
                      TempFahr = TempCels*9/5+32,
                      Location = rep(letters[1:2], each=50))
  my.tibble
```

```
# A tibble: 100 x 3
   TempCels TempFahr Location
      <int>    <dbl> <chr>
 1       13     55.4 a
 2       23     73.4 a
 3       14     57.2 a
 4       17     62.6 a
 5       32     89.6 a
 6        3     37.4 a
 7       23     73.4 a
 8       -9     15.8 a
 9       20     68   a
10       21     69.8 a
# i 90 more rows
```

Use the penguins data frame from the `palmerpenguins` package:

```
#install.packages("palmerpenguins")
library(palmerpenguins)
data(penguins)
dim(penguins)
```

```
[1] 344   8
```

```
class(penguins)
```

```
[1] "tbl_df"     "tbl"        "data.frame"
```

```
penguins
```

```
# A tibble: 344 x 8
   species island    bill_length_mm bill_depth_mm flipper_length_mm body_mass_g
   <fct>   <fct>              <dbl>         <dbl>             <int>       <int>
 1 Adelie  Torgersen           39.1          18.7               181        3750
 2 Adelie  Torgersen           39.5          17.4               186        3800
 3 Adelie  Torgersen           40.3          18                 195        3250
 4 Adelie  Torgersen           NA            NA                  NA          NA
 5 Adelie  Torgersen           36.7          19.3               193        3450
 6 Adelie  Torgersen           39.3          20.6               190        3650
 7 Adelie  Torgersen           38.9          17.8               181        3625
 8 Adelie  Torgersen           39.2          19.6               195        4675
 9 Adelie  Torgersen           34.1          18.1               193        3475
10 Adelie  Torgersen           42            20.2               190        4250
# i 334 more rows
# i 2 more variables: sex <fct>, year <int>
```

CONVERT A DATAFRAME INTO A TIBBLE

```
pe <-as_tibble(penguins)
class(pe)
```

```
[1] "tbl_df"     "tbl"        "data.frame"
```

```
pe
```

```
# A tibble: 344 x 8
   species island    bill_length_mm bill_depth_mm flipper_length_mm body_mass_g
   <fct>   <fct>              <dbl>         <dbl>             <int>       <int>
 1 Adelie  Torgersen           39.1          18.7               181        3750
 2 Adelie  Torgersen           39.5          17.4               186        3800
 3 Adelie  Torgersen           40.3          18                 195        3250
 4 Adelie  Torgersen           NA            NA                  NA          NA
 5 Adelie  Torgersen           36.7          19.3               193        3450
 6 Adelie  Torgersen           39.3          20.6               190        3650
 7 Adelie  Torgersen           38.9          17.8               181        3625
 8 Adelie  Torgersen           39.2          19.6               195        4675
 9 Adelie  Torgersen           34.1          18.1               193        3475
10 Adelie  Torgersen           42            20.2               190        4250
# i 334 more rows
# i 2 more variables: sex <fct>, year <int>
```

mode is a mutually exclusive classification of objects according to their basic structure.

```
x <- 1:16
mode(x)
```

```
[1] "numeric"
```

class is a property assigned to an object that determines how generic functions operate with it.

```
dim(x) <- c(4,4)
class(x)
```

```
[1] "matrix" "array"
```

```
is.numeric(x)
```

```
[1] TRUE
```

```
mode(x) <- "character"
mode(x)
```

```
[1] "character"
```

```
  class(x)
```

```
[1] "matrix" "array"
```

```
  #mode changed from 'numeric' to 'character', but class stays 'matrix'
```

HOWEVER,

```
  x <- factor(x)
  class(x)
```

```
[1] "factor"
```

```
  mode(x)
```

```
[1] "numeric"
```

A set of ‘is.xxx()‘ functions can be used to check the data structure of an object

```
  is.array(x)
```

```
[1] FALSE
```

```
  is.list(x)
```

```
[1] FALSE
```

```
  is.data.frame(x)
```

```
[1] FALSE
```

```
  is.matrix(x)
```

```
[1] FALSE
```

```
  is_tibble(x)
```

```
[1] FALSE
```

```
  is.vector(x)
```

```
[1] FALSE
```

```
  typeof(x)
```

```
[1] "integer"
```

Subsetting a tibble results in a smaller tibble

```
  class(pe[1:15, c("bill_length_mm", "bill_depth_mm")])
```

```
[1] "tbl_df"     "tbl"        "data.frame"
```

```
  class(penguins[1:15, c("bill_length_mm", "bill_depth_mm")])
```

```
[1] "tbl_df"     "tbl"        "data.frame"
```

```
  class(pe[1:15, c("bill_length_mm")])
```

```
[1] "tbl_df"     "tbl"        "data.frame"
```

```
  class(penguins[1:15, c("bill_length_mm")])
```

```
[1] "tbl_df"     "tbl"        "data.frame"
```

- DPLYR:

select() selects a subset of columns of the dataset.

filter() select a subset of rows.

```r
#install.packages("dplyr")
library(dplyr)
```

Select bill lengths and widths of species Adelie:

```r
select(filter(pe, species=="Adelie"), bill_length_mm, bill_depth_mm)
```

```
# A tibble: 152 x 2
   bill_length_mm bill_depth_mm
            <dbl>         <dbl>
 1           39.1          18.7
 2           39.5          17.4
 3           40.3          18
 4           NA            NA
 5           36.7          19.3
 6           39.3          20.6
 7           38.9          17.8
 8           39.2          19.6
 9           34.1          18.1
10           42            20.2
# i 142 more rows
```

```r
filter(select(pe, bill_length_mm, bill_depth_mm, species), species=="Adelie")
```

```
# A tibble: 152 x 3
   bill_length_mm bill_depth_mm species
            <dbl>         <dbl> <fct>
 1           39.1          18.7 Adelie
 2           39.5          17.4 Adelie
 3           40.3          18   Adelie
 4           NA            NA   Adelie
 5           36.7          19.3 Adelie
 6           39.3          20.6 Adelie
 7           38.9          17.8 Adelie
 8           39.2          19.6 Adelie
 9           34.1          18.1 Adelie
10           42            20.2 Adelie
# i 142 more rows
```

```r
pe
```

```
# A tibble: 344 x 8
   species island    bill_length_mm bill_depth_mm flipper_length_mm body_mass_g
   <fct>   <fct>              <dbl>         <dbl>             <int>       <int>
 1 Adelie  Torgersen           39.1          18.7               181        3750
 2 Adelie  Torgersen           39.5          17.4               186        3800
 3 Adelie  Torgersen           40.3          18                 195        3250
 4 Adelie  Torgersen           NA            NA                  NA          NA
 5 Adelie  Torgersen           36.7          19.3               193        3450
 6 Adelie  Torgersen           39.3          20.6               190        3650
 7 Adelie  Torgersen           38.9          17.8               181        3625
 8 Adelie  Torgersen           39.2          19.6               195        4675
 9 Adelie  Torgersen           34.1          18.1               193        3475
10 Adelie  Torgersen           42            20.2               190        4250
# i 334 more rows
# i 2 more variables: sex <fct>, year <int>
```

```
pe[pe$species=='Adelie', c("bill_length_mm", "bill_depth_mm")]
```

```
# A tibble: 152 x 2
   bill_length_mm bill_depth_mm
            <dbl>         <dbl>
 1           39.1          18.7
 2           39.5          17.4
 3           40.3          18
 4           NA            NA
 5           36.7          19.3
 6           39.3          20.6
 7           38.9          17.8
 8           39.2          19.6
 9           34.1          18.1
10           42            20.2
# i 142 more rows
```

```
subset(pe, pe$species=='Adelie', c("bill_length_mm", "bill_depth_mm"))
```

```
# A tibble: 152 x 2
   bill_length_mm bill_depth_mm
            <dbl>         <dbl>
 1           39.1          18.7
 2           39.5          17.4
```

```
 3           40.3          18
 4           NA            NA
 5           36.7          19.3
 6           39.3          20.6
 7           38.9          17.8
 8           39.2          19.6
 9           34.1          18.1
10           42            20.2
# i 142 more rows
```

```
  select(pe, bill_length_mm, bill_depth_mm, species) |> filter(species=="Adelie")
```

```
# A tibble: 152 x 3
   bill_length_mm bill_depth_mm species
            <dbl>         <dbl> <fct>
 1           39.1          18.7 Adelie
 2           39.5          17.4 Adelie
 3           40.3          18   Adelie
 4           NA            NA   Adelie
 5           36.7          19.3 Adelie
 6           39.3          20.6 Adelie
 7           38.9          17.8 Adelie
 8           39.2          19.6 Adelie
 9           34.1          18.1 Adelie
10           42            20.2 Adelie
# i 142 more rows
```

EXERCISE:

Pass the result from the filter to the select function and achieve the same result as shown above.

```
  filter(pe, species=="Adelie") |> select(bill_length_mm, bill_depth_mm, species)
```

```
# A tibble: 152 x 3
   bill_length_mm bill_depth_mm species
            <dbl>         <dbl> <fct>
 1           39.1          18.7 Adelie
 2           39.5          17.4 Adelie
 3           40.3          18   Adelie
 4           NA            NA   Adelie
```

```
 5           36.7          19.3 Adelie
 6           39.3          20.6 Adelie
 7           38.9          17.8 Adelie
 8           39.2          19.6 Adelie
 9           34.1          18.1 Adelie
10           42            20.2 Adelie
# i 142 more rows
```

Create a data object to hold student names (`Judy`, `Max`, `Dan`) and their grades (‘78,85,99) `Convert number grades to letter grades`:90-100:A;80-89:B;70-79:C; \<70:F‘

```
students <- list(names=c("Judy", "Max", "Dan"),
                 grades=c(78, 85, 99))
print ("before:")
```

```
[1] "before:"
```

```
students
```

```
$names
[1] "Judy" "Max"  "Dan"

$grades
[1] 78 85 99
```

```
gradeConvertor<- function (grade){
  grade = as.numeric(grade)
  if(grade > 100 | grade < 0) print ("grade out of the range")
  else if(grade >= 90 & grade <= 100) return ("A")
  else if(grade >= 80 & grade < 90) return ("B")
  else if(grade >= 70 & grade < 80) return ("C")
  else return ("F")
}

#students$grades <-sapply(students$grades, gradeConvertor)

for(i in 1:length(students$grades)){
  students$grades[i] = gradeConvertor(students$grades[i])
}
```

```
  print ("after:")
```

```
[1] "after:"
```

```
  students
```

```
$names
[1] "Judy" "Max"  "Dan"

$grades
[1] "C" "B" "A"
```