Introduction to R

BIOE 498/598 PJ

1/21/2022

Everything is a vector

Vectors are built with the `c()` function (for "combine")

```
a <- c(10, 20, 30, 40)
a
```

```
## [1] 10 20 30 40
```

Vectors are 1-indexed (like Matlab, Fortran, or Julia)

```
a[1]
```

```
## [1] 10
```

```
a[2:4]
```

```
## [1] 20 30 40
```

Some R artifacts

For historical reasons, R assigns objects to variables using <- (said "gets")

```
a <- c(10, 20, 30, 40)
```

However, the equals sign also works

```
a = c(11, 22, 33, 44)
```

Also, periods are allowed in variables names

```
a.var.name <- 7
is.na(a.var.name)
```

```
## [1] FALSE
```

It's best to avoid this and use underscores (_) instead

Vector Types

Numeric

```
r <- rnorm(4)
r
```

```
## [1]  1.3493629 -0.2646543  1.9097851  0.4067838
```

Logical (`TRUE` and `FALSE` can be abbreviated `T` and `F`)

```
r < 0.0
```

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

Character

```
c <- c("this", "is", "a", "character")
```

Notes about characters

Everything is a vector of "strings"; there are no individual "letters"

```
s <- "a string"
length(s)
```

```
## [1] 1
```

```
s[1]
```

```
## [1] "a string"
```

```
s[2]
```

```
## [1] NA
```

Notes about characters (continued)

```
nchar("a string")
```

```
## [1] 8
```

```
c <- c("this", "is", "a", "character")
length(c)
```

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

```
nchar(c)
```

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

Everything in a vector is the same type

R will convert objects into the same type

```
c(1, 2, "three")
```

```
## [1] "1"     "2"     "three"
```

For mixed types, use a `list`

```
list(1, 2, "three")
```

```
## [[1]]
## [1] 1
##
## [[2]]
## [1] 2
##
## [[3]]
## [1] "three"
```

Factors are special vectors

Factors look like regular vectors

```
x1 <- as.factor(c("wt", "ko", "wt"))
x1
```

```
## [1] wt ko wt
## Levels: ko wt
```

Factors are special vectors

Factors look like regular vectors

```
x1 <- as.factor(c("wt", "ko", "wt"))
x1
```

```
## [1] wt ko wt
## Levels: ko wt
```

But they are stored as integers and a "key" of levels

```
as.integer(x1)
```

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

```
levels(x1)
```

```
## [1] "ko" "wt"
```

Functions

Most functions are *vectorized* and operate elementwise

```
a <- runif(4)
a
```

```
## [1] 0.7240759 0.7865879 0.2458798 0.1849558
```

```
10*a + 1
```

```
## [1] 8.240759 8.865879 3.458798 2.849558
```

```
sqrt(a) + cos(a)
```

```
## [1] 1.600038 1.593163 1.465786 1.413009
```

You can always ask for help: `?sqrt`.

Data Frames

Data frames hold tables of data.

```
data <- read.csv("MonkeyThrow.csv")
data
```

```
##   run  hand hat boots distance
## 1   5  left yes   yes      4.5
## 2   6 right yes   yes      6.0
## 3   2  left  no   yes      7.0
## 4   7 right  no   yes      9.5
## 5   1  left yes    no      5.0
## 6   8 right yes    no      6.5
## 7   4  left  no    no      4.0
## 8   3 right  no    no      7.5
```

Size of Data Frames

```
nrow(data)
```

```
## [1] 8
```

```
ncol(data)
```

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

The `length` of a data frame is the number of *columns*.

```
length(data)
```

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

What are data frames?

```
head(data, n=5) # just the first 5 rows
```

```
##   run  hand hat boots distance
## 1   5  left yes   yes      4.5
## 2   6 right yes   yes      6.0
## 3   2  left  no   yes      7.0
## 4   7 right  no   yes      9.5
## 5   1  left yes    no      5.0
```

- Each column in a data frame is a vector (and must be the same type).
- Each row contains data of different types

What types ("classes") of data are in our data frame?

```
lapply(data, class)  # applies `class` to each column
```

```
## $run
## [1] "integer"
##
## $hand
## [1] "factor"
##
## $hat
## [1] "factor"
##
## $boots
## [1] "factor"
##
## $distance
## [1] "numeric"
```

Working with columns

```
data$hat
```

```
## [1] yes yes no  no  yes yes no  no
## Levels: no yes
```

```
log10(data$distance)
```

```
## [1] 0.6532125 0.7781513 0.8450980 0.9777236 0.6989700 0.
## [8] 0.8750613
```

Making new columns

```
data$log_dist <- log10(data$distance)
data
```

```
##   run  hand hat boots distance  log_dist
## 1   5  left yes   yes      4.5 0.6532125
## 2   6 right yes   yes      6.0 0.7781513
## 3   2  left  no   yes      7.0 0.8450980
## 4   7 right  no   yes      9.5 0.9777236
## 5   1  left yes    no      5.0 0.6989700
## 6   8 right yes    no      6.5 0.8129134
## 7   4  left  no    no      4.0 0.6020600
## 8   3 right  no    no      7.5 0.8750613
```

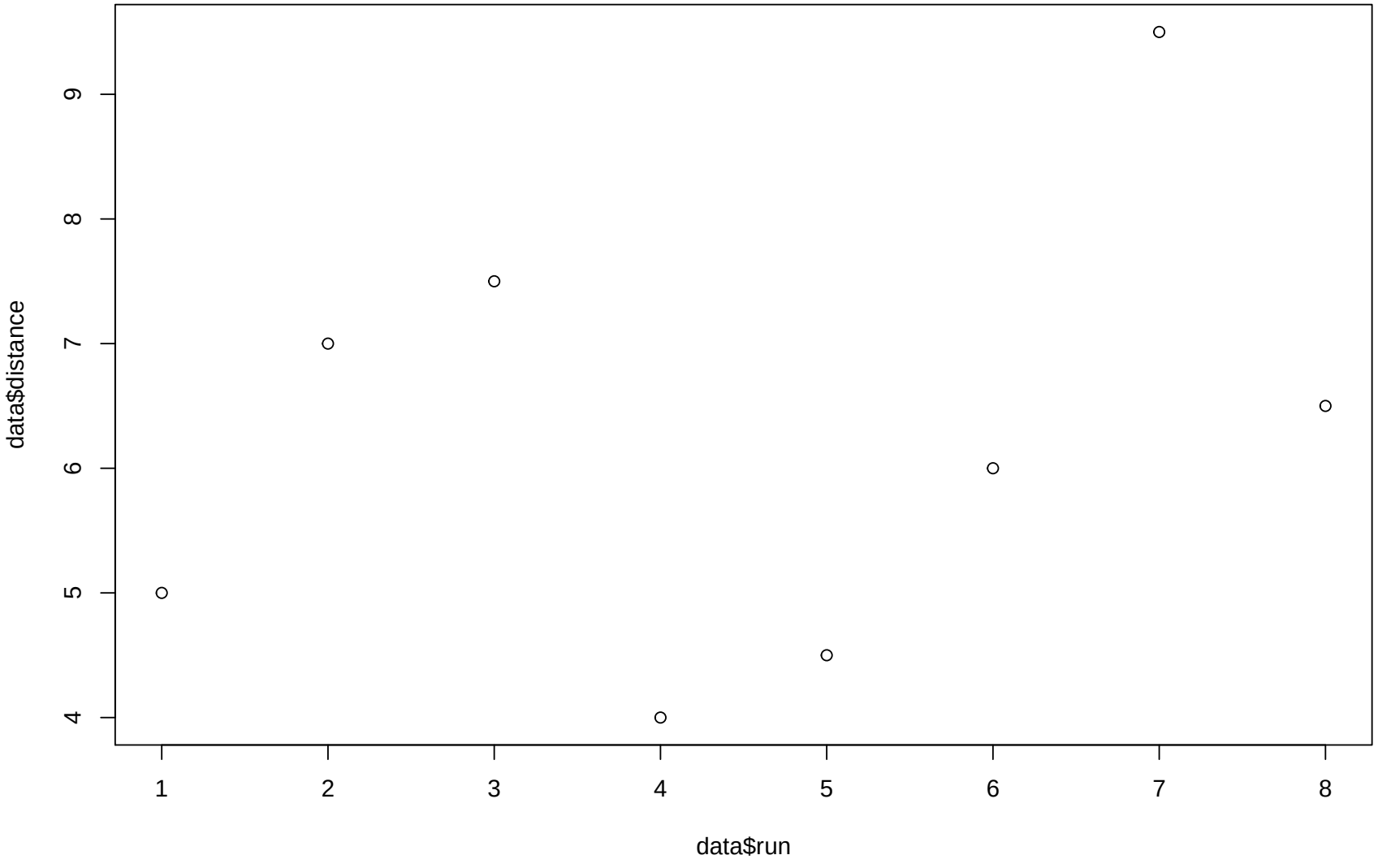
Nevermind, let's delete that column

```
data$log_dist <- NULL
data
```

```
##   run  hand hat boots distance
## 1   5  left yes   yes      4.5
## 2   6 right yes   yes      6.0
## 3   2  left  no   yes      7.0
## 4   7 right  no   yes      9.5
## 5   1  left yes    no      5.0
## 6   8 right yes    no      6.5
## 7   4  left  no    no      4.0
## 8   3 right  no    no      7.5
```

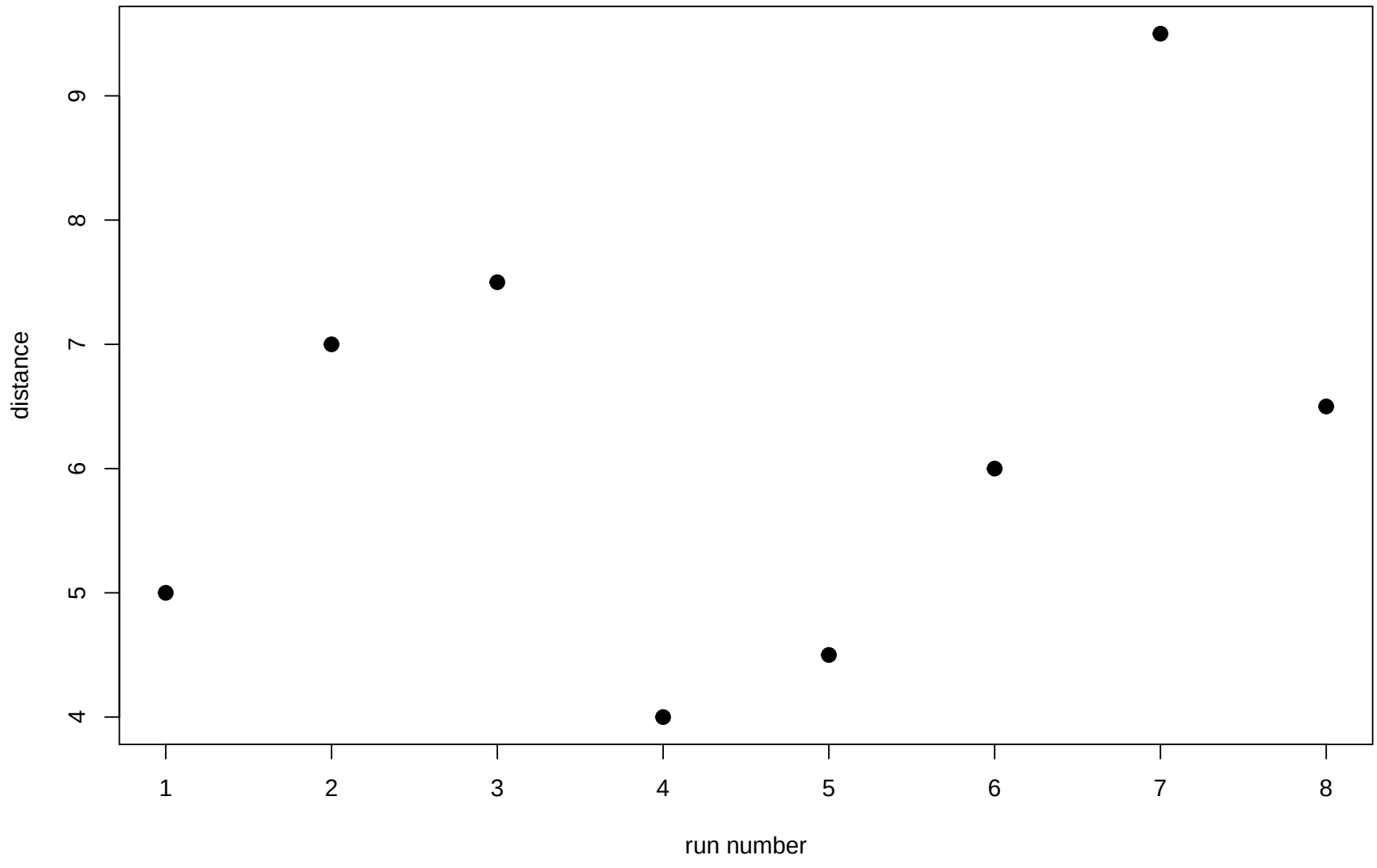
Visualizing data

```
plot(data$run, data$distance)
```



We can do better

```
plot(data$run, data$distance, xlab="run number",
     ylab="distance", cex=2, pch=20)
```



Libraries

Many of the functions we use are in libraries. We need to load the library first.

```
library("doetools") # include `farplot` function
farplot(data, response="distance", factors=c("hand", "hat", "boots"))
```