

Biometry. Lecture 9

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- 1 R and data
 - Missing data
 - Outliers
 - Data conversion and normalization
- 2 Inside R: Matrices, lists and data frames
 - Matrices
 - Lists



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```
> setwd("<working folder>")  
or  
"Change dir"  
in menu!
```

On Mac, be sure that startup option is working: `getwd()`
(`getwd()` checks if R is in working folder, `dir()` checks the folder
content)



Dotcharts for fractions and percents

These kinds of plots are often much better to read than bar plots and pie charts:

```
> height.2 <- cut(height, 3,  
+ labels=c("low", "middle", "high"))  
> dotchart(table(height.2)) # ignore the warning
```



Ranks and ties

```
> a1 <- c(1,2,3,4,4,5,7,7,7,9,15,17)
> a2 <- c(1,2,3,4,5,7,7,7,9,15,17)
> names(a1) <- rank(a1)
> a1
> names(a2) <- rank(a2)
> a2
```

Ranks may be decimal, same numbers will have same ranks (ties) and R will tell about that: try, for example

```
> wilcox.test(a2)
```



R and data

Missing data



Missing data is always here

- All real world data have problems
- Numbers may be corrupted, missed, unknown, duplicated etc.
- “Missing data” is often used to cover part of these cases



Entering missing data

We asked seven office co-workers about their average time of sleep. One denied to answer, other answered “I don’t know”, the third was not in the office at the moment:

```
> h <- c(8, 10, NA, NA, 8, NA, 8)
> h
```



How to operate with NA

```
> mean(h) # error!  
> mean(h, na.rm=TRUE)  
> mean(na.omit(h))
```



Missing data imputation

```
> h.old <- h  
> h[is.na(h)] <- mean(h, na.rm=TRUE)  
> h
```



R and data

Outliers



Too big or too small

- Outliers are results of mistypes, misprints and other random events
- It is possible to recognize them using `table()` and `summary()` functions

```
> h.1 <- c(8, 10, NA, NA, 8, NA, 8, 80)
> table(h.1)
> summary(h.1)
> h[!(h.1 > 24)]
```



R and data

Data conversion and normalization



Logarithmic conversion

- Very often the bell-shape curve or linear relation may be achieved by logarithmic conversion
- In R, it is possible to apply `log()` (natural logarithm) function to any vector. The only problem is that the data should not contain zeroes.
- Other mathematical conversions also exist, e.g., square root conversion.



Scaling data

Function `scale()` will convert all columns of data frame to the same scale:

```
> a <- 1:10
> b <- seq(100, 1000, 100)
> d <- data.frame(a, b)
> d
> scale(d)
```

Columns `a` and `b` became identical!



Inside R: Matrices, lists and data frames

Matrices



What we already know of R internals

- We already know integer, numeric, character and logical *vectors*. All vectors could be *named*.
- In addition, R has *factors* (ordered or unordered)



Matrices are vectors

- In R, numeric tables (*matrices*) are simply vectors with two dimensions.
- It is also possible to create multidimensional *arrays*.



Matrix and vector

```
> m <- 1:4
> ma <- matrix(m, ncol=2, byrow=TRUE)
> str(ma)
> str(m)
> mb <- m
> dim(mb) <- c(2,2)
> mb
```

The structure of objects `m` and `ma` are not significantly different, only screen output is not similar (try it!). Function `dim()` will add dimensions to vector transforming it into matrix or array.



Three-dimensional matrix (array)

```
> m3 <- 1:8  
> dim(m3) <- c(2,2,2)  
> m3
```



Inside R: Matrices, lists and data frames

Lists



List is a collection of everything

- List may contain any type of objects
- Moreover, list can contain other lists, and so on



List examples

```
> l <- list("R", 1:3, TRUE, NA, list("r", 4))
> l
> str(l)
> fred <- (name="Fred", wife="Mary", no.children=3,
+ child.ages=c(5,9))
> fred
```



Indexing of vectors, matrices and lists

```
> m[3] # third element of vector m
> ma[2, 1] # second row, first column
> l[1] # lists may be indexed like vectors
> str(l[1]) # it's a list!
> l[[1]] # not the same as l[1]!
> str(l[[1]]) # it's a vector!
```



Finishing...

Save your commands!

`(savehistory(<today's date>.r)` or File -> Save as... on
Mac)



Summary: most important commands

- NA is a missing data
- [—selects an element, row or column
- \$—selects by name from list or data frame



For Further Reading



A. Shipunov.

Biometry [Electronic resource].

2012—onwards.

Mode of access:

http://ashipunov.info/shipunov/school/biol_240



A. Shipunov, and others.

Visual statistics. Use R!

Ongoing translation from Russian.

