

Biometry. Lecture 8

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1 Types of data

- Measurement (interval) data
- Ranked (ordinal) data
- Nominal (categorical) data



```
> 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)



About color numbers

```
> plot(1:20, col=1:20)  
> palette() # you can change palette but default are 8 colors
```



Types of data

Measurement (interval) data



Measurement (interval) data

- For any two measurements, the third between them also has sense
- Best example: location on the ruler. Continuous, could be zero, positive and negative.
- Temperature has a restriction: there is a minimal temperature
- Angle is worse: there are both minimal and maximal angles



Discrete measurement data: counts

- This is the other kind of measurement data
- Number of items is always a whole number so there is the third between 2 and 4
- But the third number between 2 and 3 is a nonsense



“Parametric” and “non-parametric” data

- (a) Only *continuous measurement* data may be parametric
- In addition, parametric methods require: (b) suspected *normal distribution* of data and (c) sample ≥ 30
- Everything else should be studied with non-parametric methods



Measurement data in R

```
> x <- c(174, 162, 188, 192, 165, 168, 172)
> str(x)
  num [1:7] 174 162 188 192 165 168 172
> is.numeric(x)
[1] TRUE
> is.vector(x)
[1] TRUE
```



Types of data

Ranked (ordinal) data



What if we cannot measure?

- In this case, we can use scale-like representation
- E.g., we can rank the student success from 1 to 5 (“very bad” to “excellent”)
- Or softness of mattress from 0 to 10 (“hard as a plank” to “soft as a cloud”)



Ranked and measurement data

- Similarity: for every two ranks, the third between them has sense
- E.g., it is possible to imagine mattress with softness between 2 and 3
- However, ranks are not represent intervals correctly!
- Ranked data should be studied with non-parametric methods



How to create ranked data

In R, ranked data is normally represented by the same numerical vector or *ordered factor*. Command `cut()` will break continuous data into ranks:

```
> height <- trees[,2]
> cut(height, 3, labels=c(1:3), ordered=T)
> cut(height, 3, ordered=T)
```



Types of data

Nominal (categorical) data



Just observations

- Some data cannot be ordered at all
- Sex, color, absence/presence are good examples
- If even we label red color as “1” and green color as “2” the “1.5” is a nonsense.
- Therefore, if we use numbers for categorical data, they are only *labels*.



Binary data

- Absence/presence is a specific subset of categorical data which only two possible values
- One of the easiest representation is with numbers 0 and 1
- Computers normally prefer binary data over non-binary



Logical data

Practically, it is just a kind of binary data:

```
> height < 72
> height >= 72
> height == 72 # not "!="
> presence <- c(F, T, T, F, F)
> presence
> presence * 1 # convert to 1/0
> (presence * 1) == 1 # convert back
```

“==” is a logical test: “Is equal?”. In R, “=” has a different meaning, it is a replacement for “<-”.



Categorical data in R

Character and logical vectors may be used for categorical data:

```
> sex <- c("male", "female", "male", "male",  
+ "female", "male", "male")  
> is.character(sex)  
> is.vector(sex)  
> str(sex)  
> str(presence)
```



Squeezing numbers from the categorical data

```
> sex <- c("male", "female", "male", "male",  
+ "female", "male", "male")  
> presence <- c(F, T, T, F, F)  
> table(sex)  
> table(presence)
```

The `table()` command will let us to have some numbers even from categorical data!



Character to factor

```
> plot(sex) # error!  
> sex.f <- as.factor(sex)  
> plot(sex.f) # makes bar plot
```

Factor is a special type of object used to represent nominal or ranked data



Features of factors

```
> is.factor(sex.f)
> is.character(sex.f)
> str(sex.f)
> levels(sex.f)
> sex.f[6:7] # two levels!
> sex.f[6:7, drop=TRUE] # one level
```

Factor has levels which will not automatically drop with a sub-setting.



Finishing...

Save your commands!

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



Summary: most important commands

- `cut()` makes ranked data
- `as.<something>()` —converts objects
- `table()` —summarizes categorical data



For Further Reading



A. Shipunov.

Biometry [Electronic resource].

2012—onwards.

Mode of access:

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



A. Shipunov, and many others.

Visual statistics. Use R!

2016—onwards.

Mode of access: http://ashipunov.info/shipunov/school/biol_240/en/visual_statistics.pdf

