

P5.2 Statistics for Medicine

Massimo Borelli

Master of Advanced Studies in Medical Physics



UNIVERSITÀ
DEGLI STUDI DI TRIESTE



The Abdus Salam
International Centre
for Theoretical Physics



- 1 What are we talking about
 - shifting Statistics from Physics to Medicine
 - frequently used softwares

shifting Statistics from Physics to Medicine

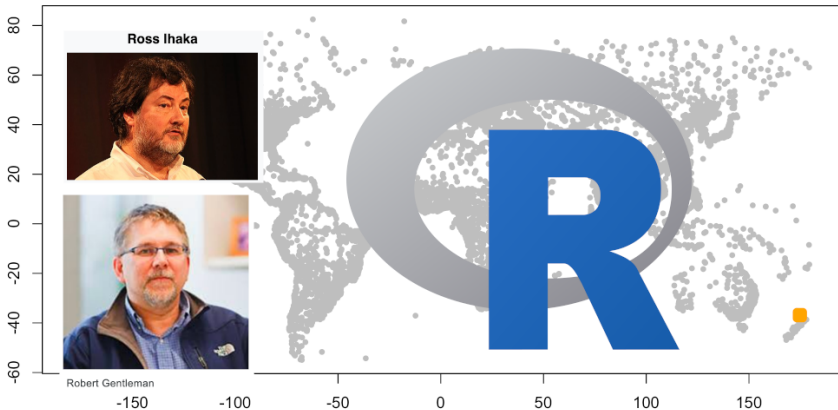
1.1 The macroscopic and the microscopic states

We consider a physical system composed of N identical particles confined to a space volume V . In a typical case, N would be an extremely large number — generally, of order 10^{23} . In view of this, it is customary to carry out analysis in the so-called *thermodynamic limit*, namely $N \rightarrow \infty, V \rightarrow \infty$ (such that the ratio N/V , which represents the *particle density* n , stays fixed at a preassigned value). In this limit, the *extensive* properties of the system

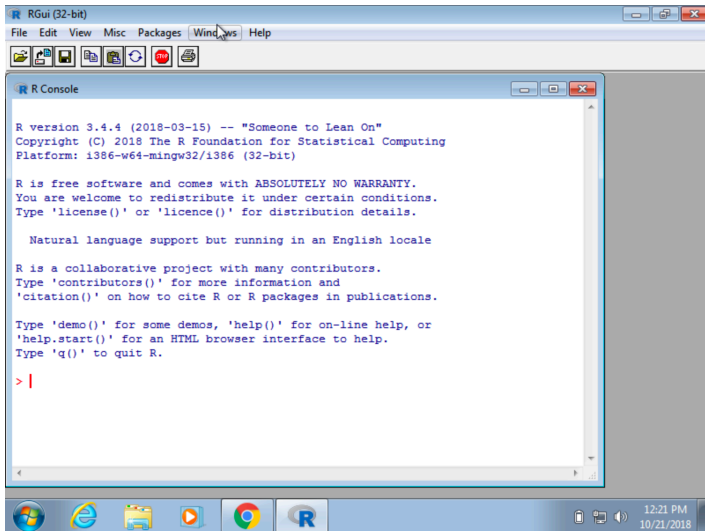
¹The third law, which is also known as *Nernst's heat theorem*, did not arrive until about 1906. For a general discussion of this law, see Simon (1930) and Wilks (1961); the references also provide an extensive bibliography on the subject.

- $N \rightarrow \infty$?
- $j \in \{1, \dots, N\}$!

Softwares used by Statisticians /1



standard interface of R /2



RGui (32-bit)

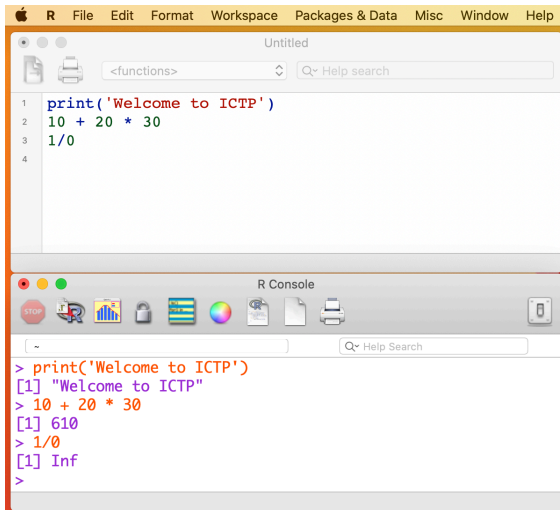
File Edit View Misc Packages Windows Help

R Console

```
R version 3.4.4 (2018-03-15) -- "Someone to Lean On"  
Copyright (C) 2018 The R Foundation for Statistical Computing  
Platform: i386-w64-mingw32/i386 (32-bit)  
  
R is free software and comes with ABSOLUTELY NO WARRANTY.  
You are welcome to redistribute it under certain conditions.  
Type 'license()' or 'licence()' for distribution details.  
  
Natural language support but running in an English locale  
  
R is a collaborative project with many contributors.  
Type 'contributors()' for more information and  
'citation()' on how to cite R or R packages in publications.  
  
Type 'demo()' for some demos, 'help()' for on-line help, or  
'help.start()' for an HTML browser interface to help.  
Type 'q()' to quit R.  
  
> |
```

Windows taskbar: 12:21 PM, 10/21/2018

working with scripts: R /3



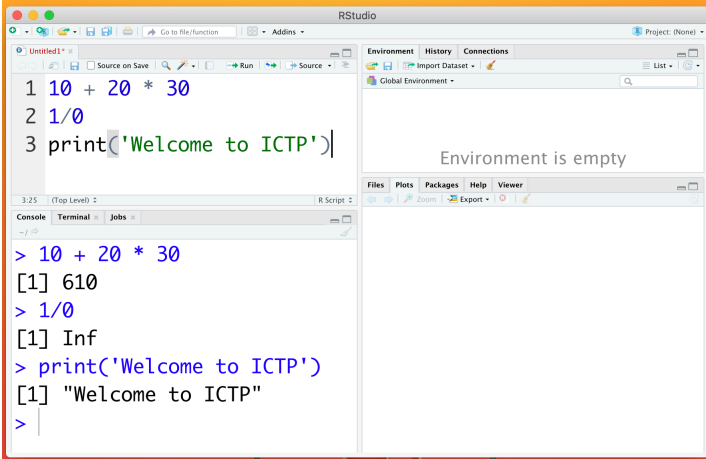
The screenshot displays the R IDE interface. The top menu bar includes Apple, R, File, Edit, Format, Workspace, Packages & Data, Misc, Window, and Help. The main editor window, titled 'Untitled', contains the following R code:

```
1 print('Welcome to ICTP')
2 10 + 20 * 30
3 1/0
4
```

Below the editor is the R Console, which shows the execution results:

```
> print('Welcome to ICTP')
[1] "Welcome to ICTP"
> 10 + 20 * 30
[1] 610
> 1/0
[1] Inf
>
```

best interface: R Studio /4



The screenshot displays the RStudio environment. The main editor window shows a script with three lines of code:

```
1 10 + 20 * 30
2 1/0
3 print('Welcome to ICTP')
```

The console window below shows the execution of these commands:

```
> 10 + 20 * 30
[1] 610
> 1/0
[1] Inf
> print('Welcome to ICTP')
[1] "Welcome to ICTP"
>
```

The Environment pane on the right indicates that the environment is empty.

Helping beginners: R Commander /5

R Commander

File Edit Data Statistics Graphs Models **Distributions** Tools Help

Data set: <No active dataset>

R Script R Markdown

```
print('Welcome to ICTP')
10 + 20 * 30
1/0
```

Output

```
> print('Welcome to ICTP')
[1] "Welcome to ICTP"

> 10 + 20 * 30
[1] 610

> 1/0
[1] Inf
```

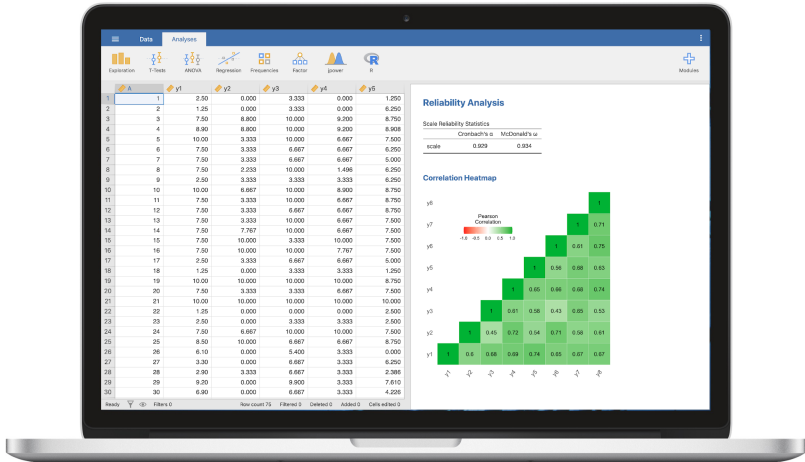
Messages

```
[1] NOTE: R Commander Version 2.6-1: Wed Dec 18 10:51:39 2019
```


Distributions menu items:

- Set random number generator seed...
- Continuous distributions
- Discrete distributions
- Normal distribution
- t distribution
- Chi-squared distribution
- F distribution
- Exponential distribution
- Uniform distribution
- Beta distribution
- Cauchy distribution
- Logistic distribution
- Lognormal distribution
- Gamma distribution
- Weibull distribution
- Gumbel distribution

Integrating spreadsheet: Jamovi /5



a promising 'new entry': JASP /6



JASP | DOWNLOAD | FEATURES | SUPPORT | TEACHING | BLOG | DONATE

A Fresh Way to Do Statistics

[Download JASP](#)

0.16 New Release
Predict with ML, models, Neural Networks, & Meta-Analysis extension

**FREE**

JASP is an open-source project supported by the University of Amsterdam.

**FRIENDLY**

JASP has an intuitive interface that was designed with the user in mind.

**FLEXIBLE**

JASP offers standard analysis procedures in both their classical and Bayesian form.

0th homework (optional, not compulsory) /1

- In hospitals, spreadsheets are routinary
- Very often data not properly masked

protecting privacy in a spreadsheet

As an exercise, download on your computer the privacy dataset (at <https://github.com/MassimoBorelli/Miramare>), explore it with your favourite spreadsheet and create a new column of data by means of a text function (or joining together the outputs of different text functions) in order to provide a unique identifier for each row ('record') of the dataset.

0th homework (optional, not compulsory) /2

- the privacy dataset

Timestamp	Name	Surname	Daybirth	Monthbirth	Yearbirth	Id
28/11/2021 10.55.31	James	Wang	29	12	1966	
28/11/2021 10.56.53	Mary	Chen	19	10	1978	
28/11/2021 10.56.59	Robert	Singh	9	7	1957	
28/11/2021 10.58.00	Patricia	Kumar	12	8	1980	
28/11/2021 11.01.35	John	Ali	11	11	1976	
28/11/2021 11.03.07	Jennifer	Nguyen	7	12	1968	
28/11/2021 11.04.33	Michael	Khan	11	9	1977	
28/11/2021 11.05.04	Linda	Ahmed	26	1	1982	
28/11/2021 11.05.55	William	Khatun	22	1	1960	
28/11/2021 11.06.14	Elizabeth	Silva	18	3	1980	
28/11/2021 11.07.27	David	Tang	13	9	1983	
28/11/2021 11.07.47	Barbara	Mohamed	2	5	1962	
28/11/2021 11.07.47	Richard	Xie	23	8	1966	
28/11/2021 11.08.19	Susan	Han	20	4	1972	
28/11/2021 11.11.10	Joseph	Garcia	22	10	1970	