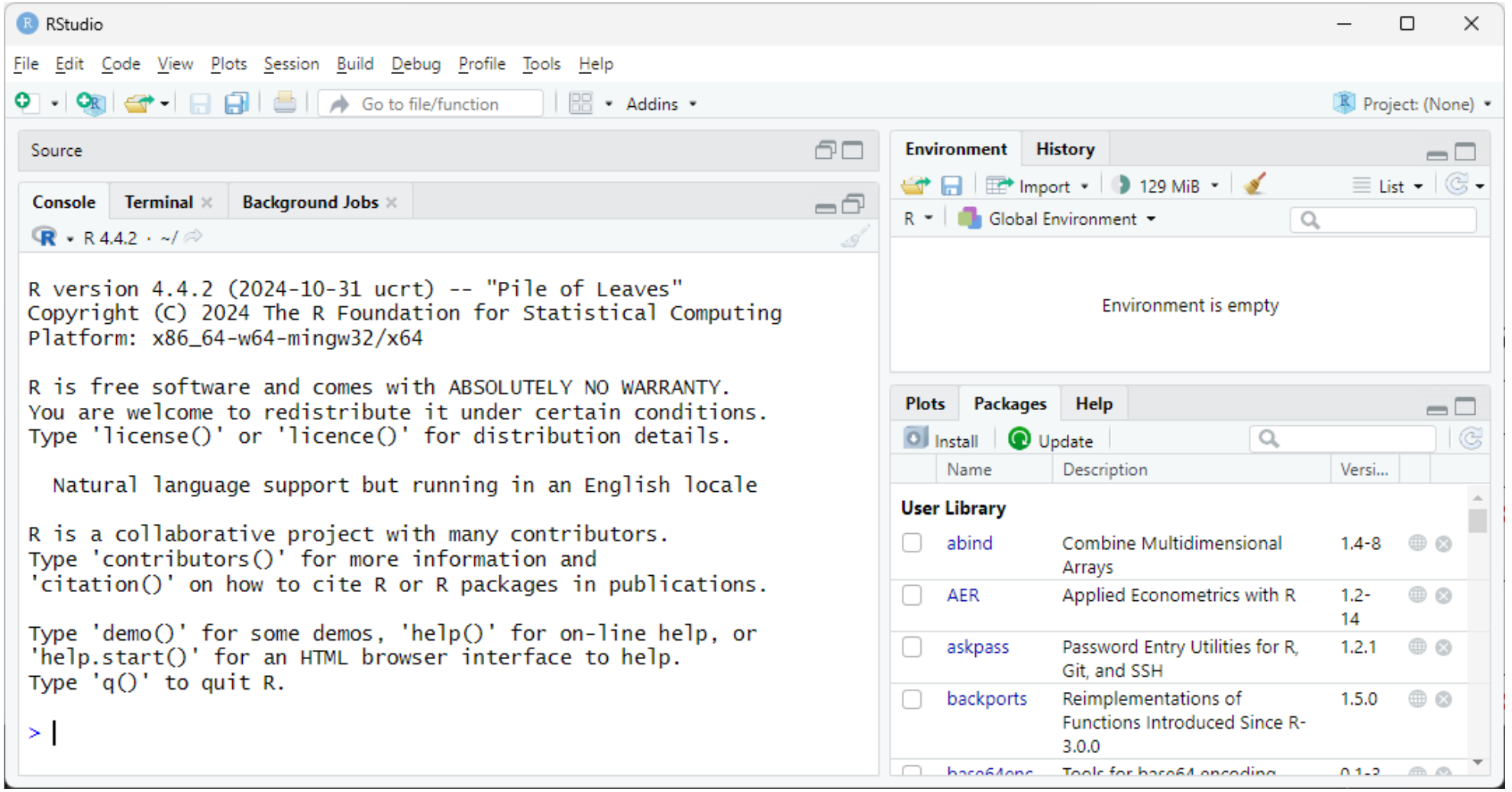
THE UNIVERSITY OF QUEENSLAND
AUSTRALIA
CREATE CHANGE

# ECON3350 - Applied Econometrics for Macroeconomics and Finance

## Tutorial 1: R and Basic Operations

Tutor: Francisco Tavares Garcia

# RStudio IDE


RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Source
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Background Jobs
R 4.4.2 · ~/
R version 4.4.2 (2024-10-31 ucrt) -- "Pile of Leaves"
Copyright (C) 2024 The R Foundation for Statistical Computing
Platform: x86_64-w64-mingw32/x64
R is free software and comes with ABSOLUTELY NO WARRANTY.
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Type 'license()' or 'licence()' for distribution details.
Natural language support but running in an English locale
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# ECON3350 – Tutorial 01

**Install R –** 4.4.2

https://cran.r-project.org/

**Install RStudio –** 2024.12.1+563

https://posit.co/download/rstudio-desktop/

**Update all packages –**

In RStudio >>

Tools >>

Check for Package Updates >>

Select All >>

Install Updates

## Who's your Tutor?

Born in 1986 in Ourinhos,
São Paulo state, Brazil

2004 – 2008
Bachelor of Computer Science
2008 – 2012
Supervisor at Procter & Gamble
2009 – 2011
MBA - FGV
2012 – 2018
Built and ran a Hostel
2021 – 2023
Bachelor of Economics – UQ
2024 – 2025
Bachelor of Mathematics - UQ

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## Econometrics/Statistics

**ECON1310** - Introductory Statistics for Social Sciences

**ECON2300** - Introductory Econometrics

**ECON2105** - Statistical Theory for Economists

**ECON3330** - Econometric Analysis

**ECON3350** - Applied Econometrics for Macroeconomics and Finance

**ECON3360** - Causal Inference for Microeconometrics

**ECON6300** - Advanced Microeconometrics

**STAT2003** - Mathematical Probability

**STAT2004** - Statistical Modelling & Analysis

**STAT3001** - Mathematical Statistics

**STAT3004** - Probability Models & Stochastic Processes

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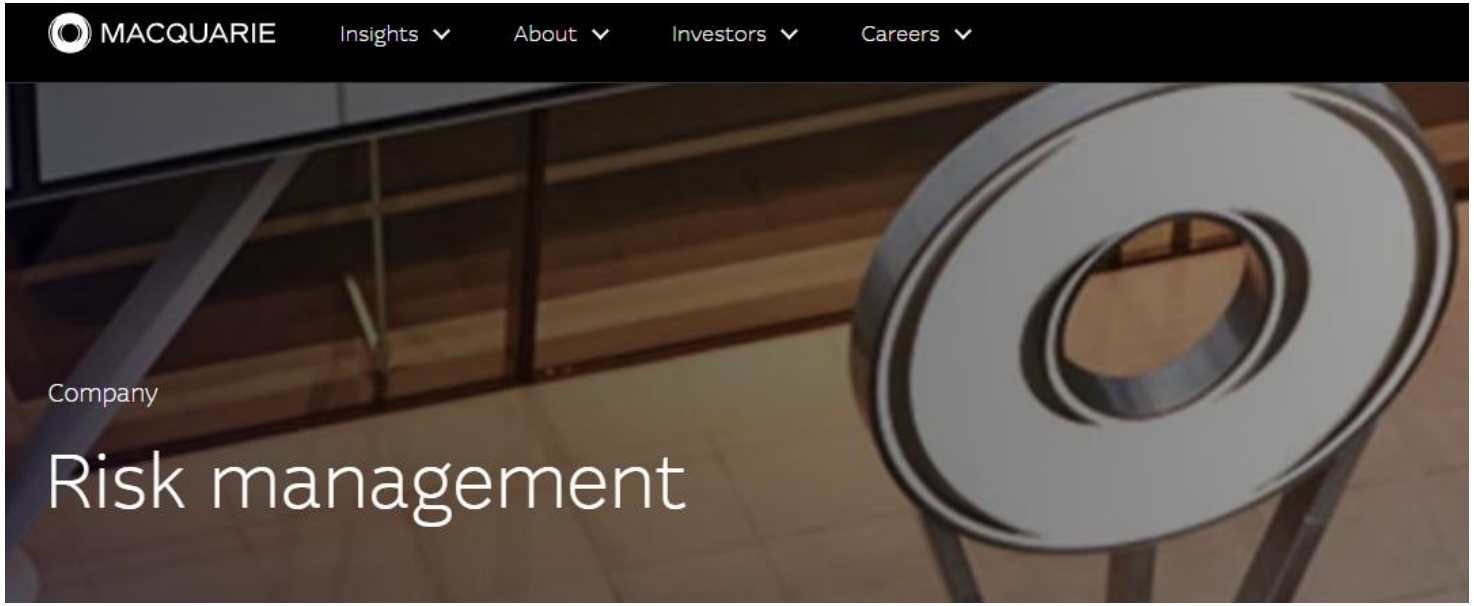


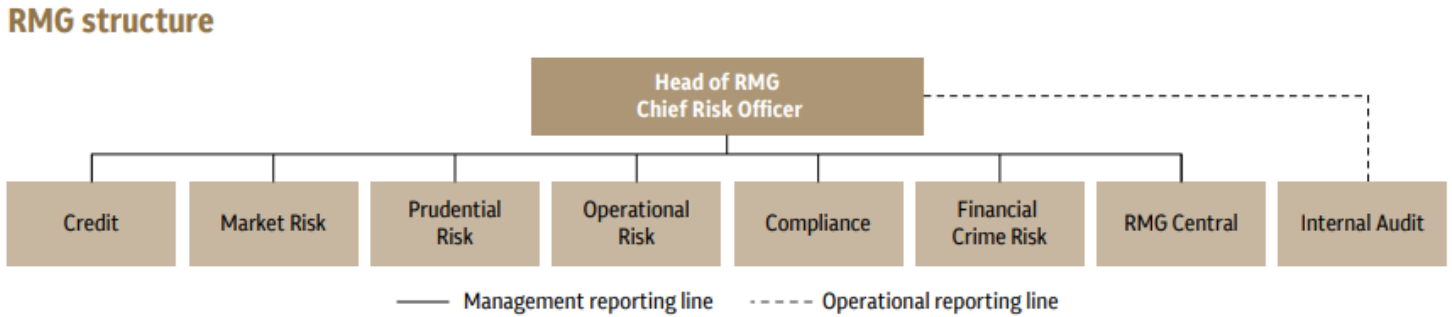

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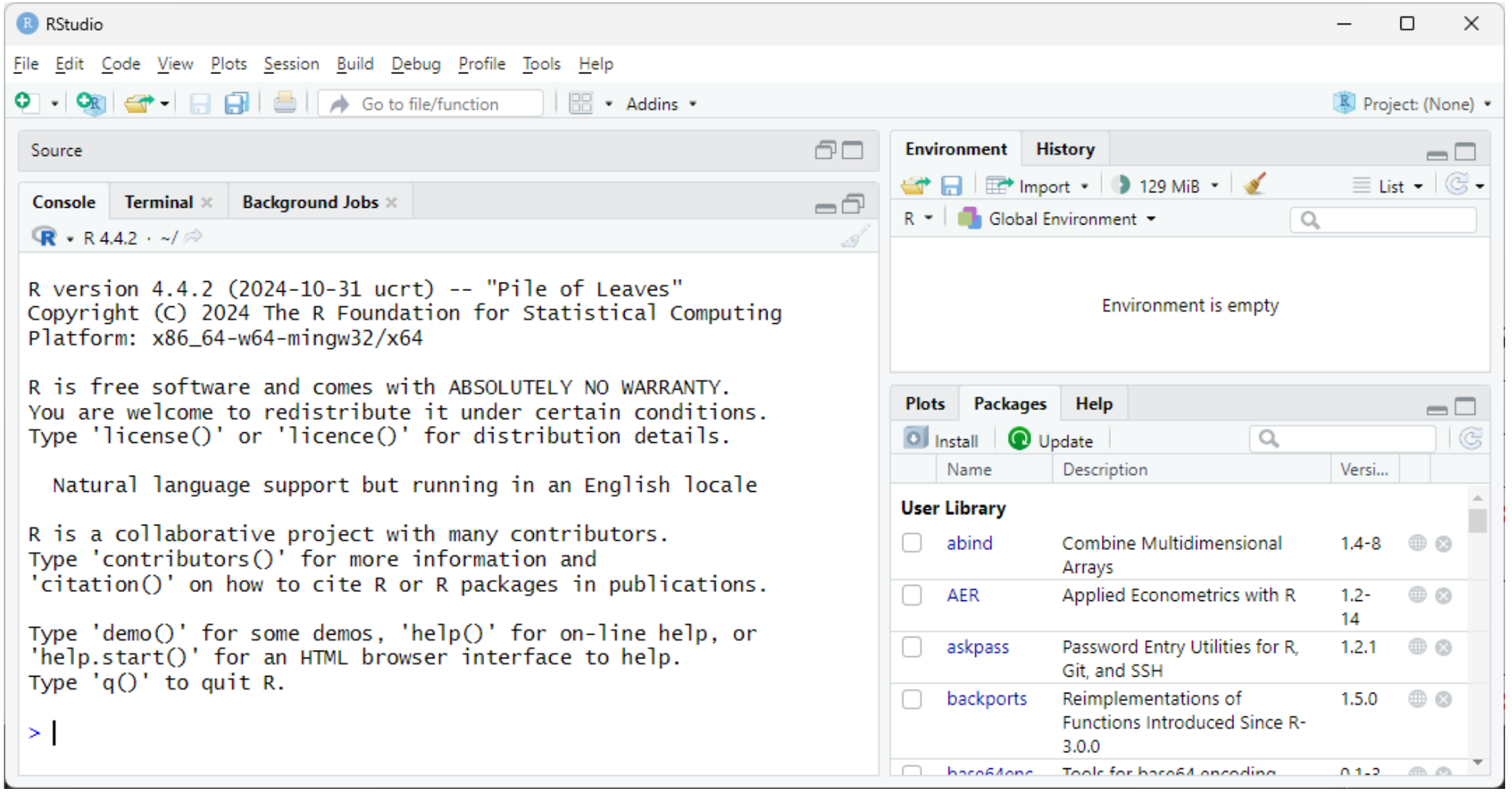
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# Assessments

## Assessment summary

| Category | Assessment task | Weight | Due date |
|---|---|---|---|
| Paper/ Report/ Annotation | Research Report 1 | 20% | 28/03/2025 1:00 pm |
| Paper/ Report/ Annotation | Research Report 2 | 30% | 9/05/2025 1:00 pm |
| Examination | Final Exam | 50% | End of Semester Exam Period |
| | Identity Verified | | 7/06/2025 - 21/06/2025 |
| | In-person | | |

# I need HELP!!!

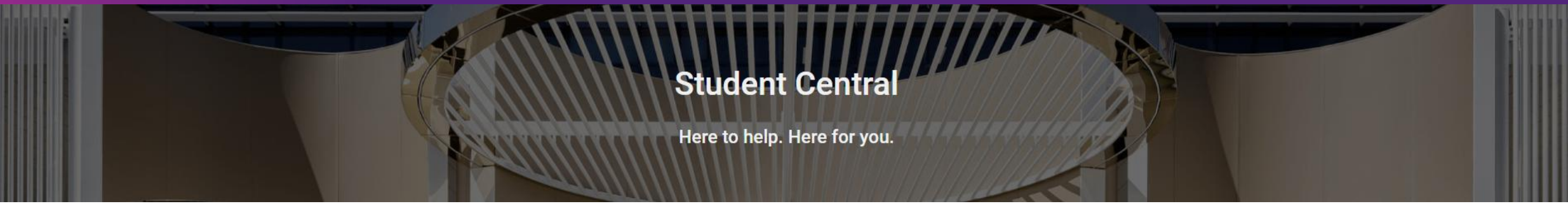
- Consultation Tuesday to Thursday!! (tutors and Rodney)

- Ed Discussion Board (Blackboard/Learn.UQ)

- econ3350@uq.edu.au – for academic questions
- econ_admin@uq.edu.au – for admin questions

Online free R books:

- https://otexts.com/fpp3/ (Forecasting in R)
- https://www.econometrics-with-r.org/
- https://bookdown.org/ndphillips/YaRrr/ (Intro R)




# I really need HELP…

## Contact us

We're here to help from Monday to Friday.

Email Student Services

**1300 275 870** (Option 2)
8.30am–5pm

**Live chat** (8.30am–4.30pm)

Chat – unavailable

## Counselling

Looking for ways to build strategies and help you overcome challenges in your life? Some areas we can provide support with, include:

- Stress
- Depression
- Anxiety
- Relationships
- Wellbeing

Book an appointment

## Wellbeing

We are here for you. Take advantage of our support and maximise your university experience. Some areas we can provide guidance on include:

- Accommodation
- Crisis support
- Financial hardship assistance
- International student support
- Health and wellbeing advice
- Academic accommodations
- Support with Disability and Inclusion

Find out more

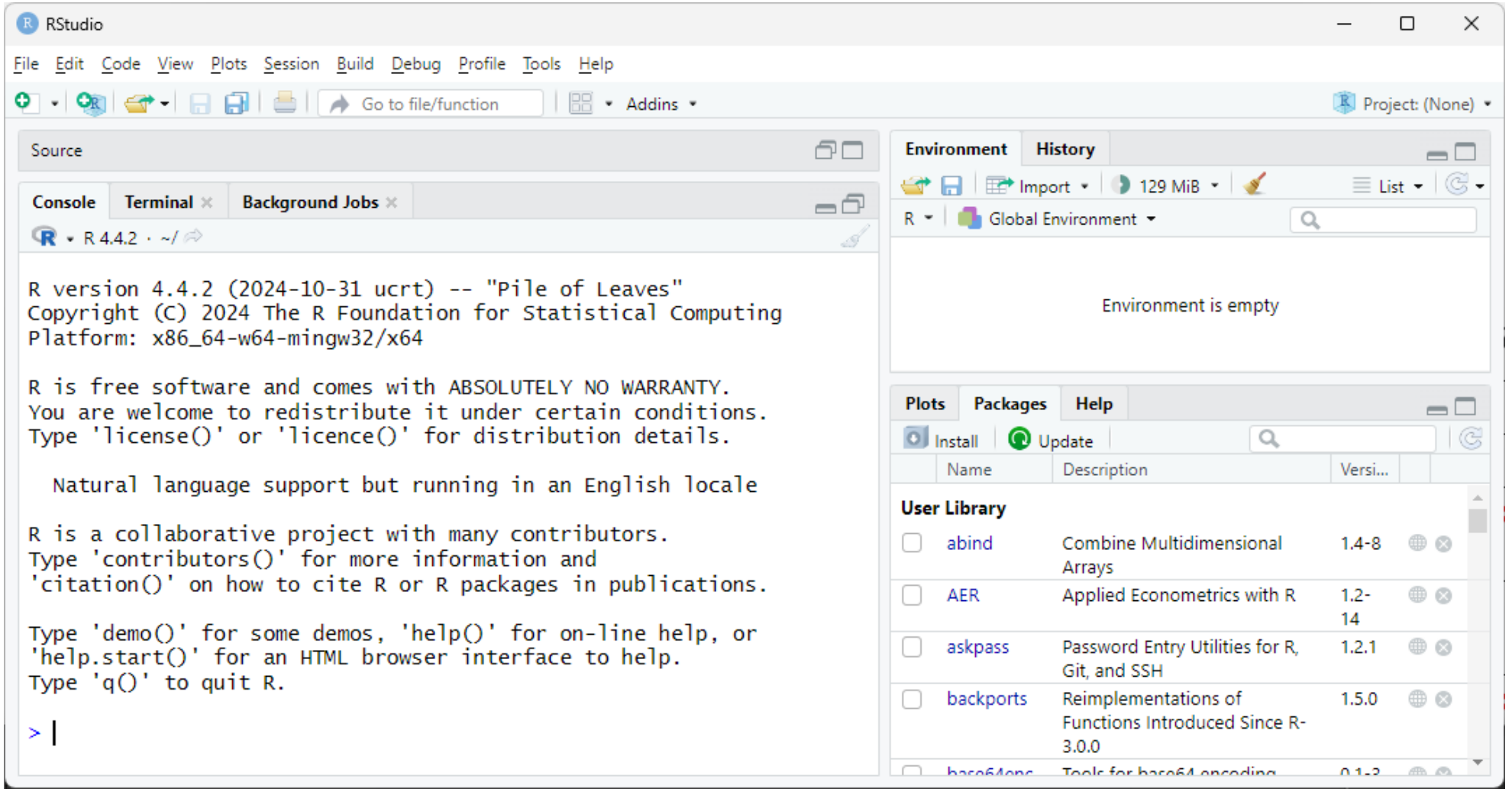
## Study skills

Set yourself up for academic success with the right tools, advice and support from our experts. Some of the areas we can support you in include:

- Academic writing
- Time management
- Learning and exam preparation
- Learning Adviser Appointments

Book an appointment

# RStudio IDE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# Installing R (not RStudio yet)

**R** base distribution – 4.4.2
https://cran.r-project.org/

## R-4.4.2 for Windows

Download R-4.4.2 for Windows (83 megabytes, 64 bit)

README on the Windows binary distribution
New features in this version

This build requires UCRT, which is part of Windows since Windows 10 and Windows Server 2016. On older systems, UCRT has to be installed manually from here.

If you want to double-check that the package you have downloaded matches the package distributed by CRAN, you can compare the md5sum of the .exe to the fingerprint on the master server.

### Frequently asked questions

- Does R run under my version of Windows?
- How do I update packages in my previous version of R?

Please see the R FAQ for general information about R and the R Windows FAQ for Windows-specific information.

## R for macOS

This directory contains binaries for the base distribution and of R and packages to run on macOS. R and package binaries for R versions older than 4.0.0 are only available from the CRAN archive so users of such versions should adjust the CRAN mirror setting (`https://cran-archive.r-project.org`) accordingly.

Note: Although we take precautions when assembling binaries, please use the normal precautions with downloaded executables.

### R 4.4.2 "Pile of Leaves" released on 2024/10/31

Please check the integrity of the downloaded package by checking the signature:
`pkgutil --check-signature R-4.4.2-arm64.pkg`
in the *Terminal* application. If Apple tools are not avaiable you can check the SHA1 checksum of the downloaded image:
`openssl sha1 R-4.4.2-arm64.pkg`

### Latest release:

For Apple silicon (M1,2,..) Macs:
R-4.4.2-arm64.pkg
SHA1-hash: 7832cb5d6cd686fd3cc54c8ab4c93c464540a944
(ca. 94MB, notarized and signed)

For older Intel Macs:
R-4.4.2-x86_64.pkg
SHA1-hash: f49ad56ce3a0ac569fd8f9668749bc861b965b5e
(ca. 96MB, notarized and signed)

**R 4.4.2** binary for macOS 11 (**Big Sur**) and higher, signed and notarized packages.

Contains R 4.4.2 framework, R.app GUI 1.81, Tcl/Tk 8.6.12 X11 libraries and Texinfo 6.8. The latter two components are optional and can be ommitted when choosing "custom install", they are only needed if you want to use the `tcltk` R package or build package documentation from sources.

macOS Ventura users: there is a known bug in Ventura preventing installations from some locations without a prompt. If the installation fails, move the downloaded file away from the *Downloads* folder (e.g., to your home or Desktop).

Note: the use of X11 (including `tcltk`) requires XQuartz (version 2.8.5 or later). Always re-install XQuartz when upgrading your macOS to a new major version.

This release uses Xcode 14.2/14.3 and GNU Fortran 12.2. If you wish to compile R packages which contain Fortran code, you may need to download the corresponding GNU Fortran compiler from https://mac.R-project.org/tools. Any external libraries and tools are expected to live in `/opt/R/arm64` (Apple silicon) or `/opt/R/x86_64` (Intel).

# Installing RStudio

**Rstudio IDE** – 2024.12.1+563
https://posit.co/download/rstudio-desktop/

DOWNLOAD

## RStudio IDE

The most popular coding environment for R, built with love by Posit.

Used by millions of people weekly, the RStudio integrated development environment (IDE) is a set of tools built to help you be more productive with R and Python. It includes a console, syntax-highlighting editor that supports direct code execution. It also features tools for plotting, viewing history, debugging and managing your workspace.

RStudio Desktop | RStudio Server

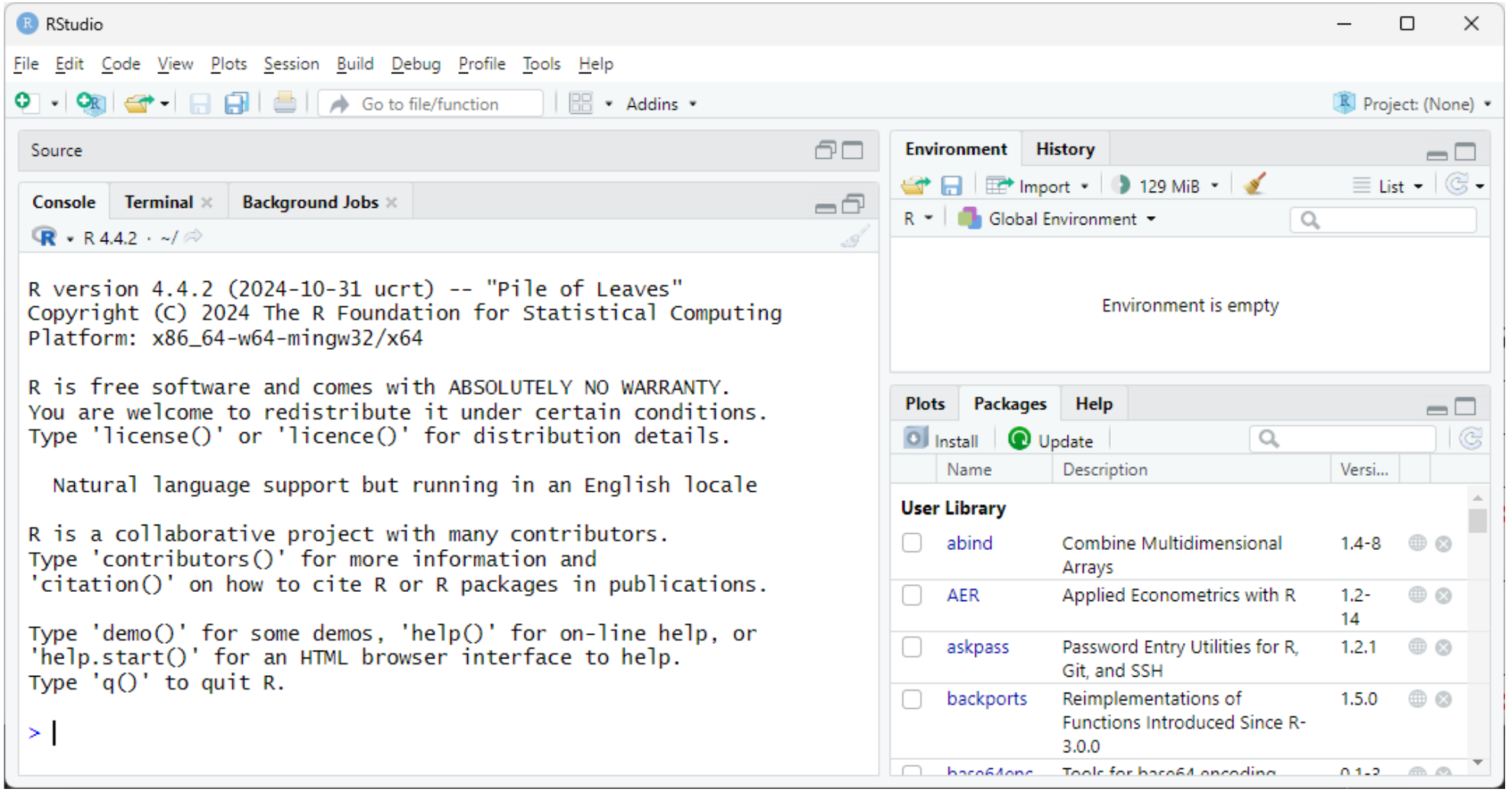
## RStudio Desktop

Find out more about RStudio Desktop and RStudio Desktop Pro below.

DOWNLOAD RSTUDIO

| OS | Download | Size | SHA-256 |
|---|---|---|---|
| Windows 10/11 | RSTUDIO-2024.12.1-563.EXE | 265.28 MB | BB369743 |
| macOS 13+ | RSTUDIO-2024.12.1-563.DMG | 557.15 MB | BE73D3A9 |
| Ubuntu 20/Debian 11 | RSTUDIO-2024.12.1-563-AMD64.DEB | 203.14 MB | EE259A88 |
| Ubuntu 22/Debian 12 | RSTUDIO-2024.12.1-563-AMD64.DEB | 203.17 MB | 710931EC |
| Ubuntu 24 | RSTUDIO-2024.12.1-563-AMD64.DEB | 203.17 MB | 710931EC |
| OpenSUSE 15 | RSTUDIO-2024.12.1-563-X86_64.RPM | 205.07 MB | 9C7E7109 |

# RStudio IDE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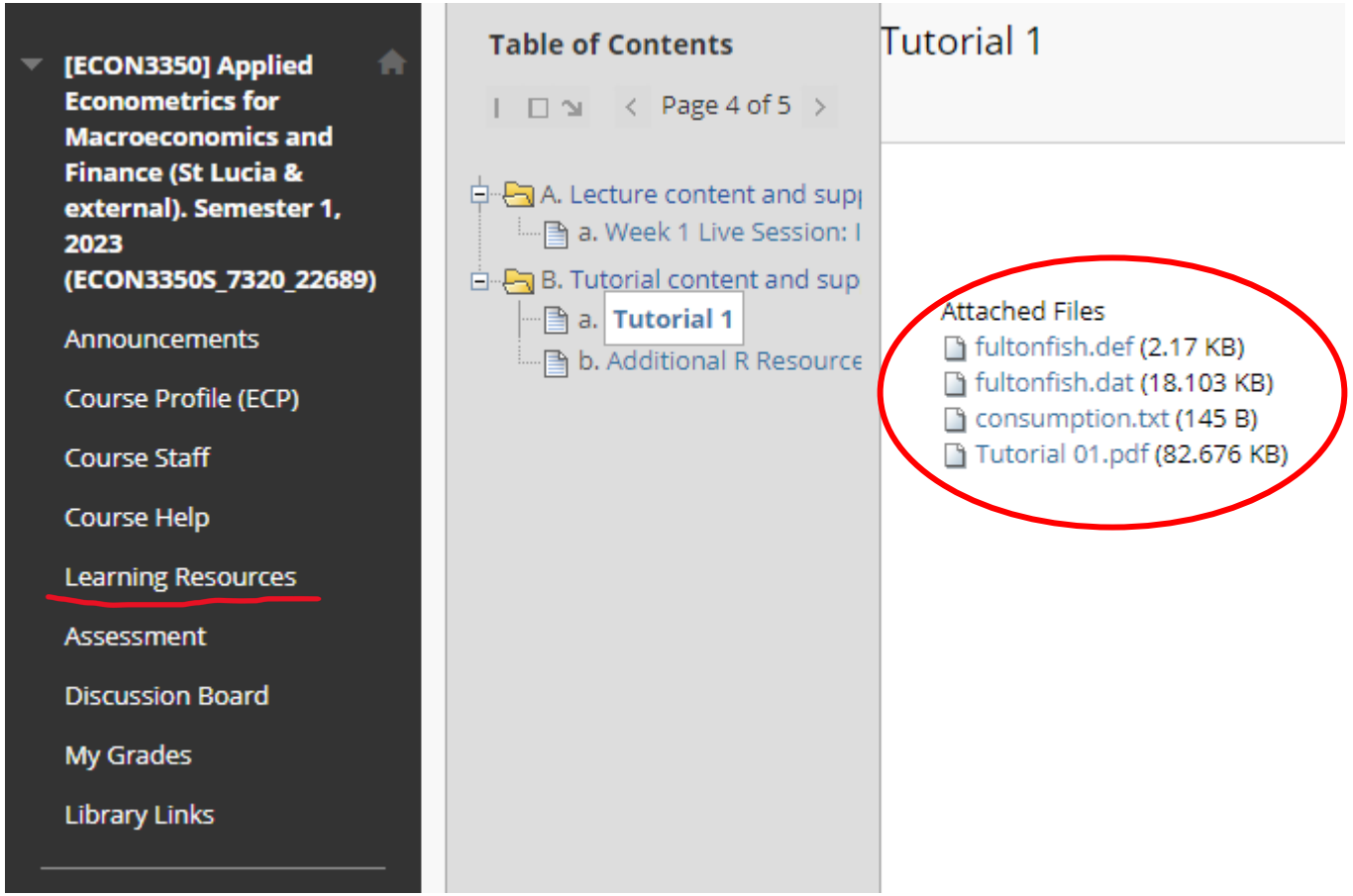
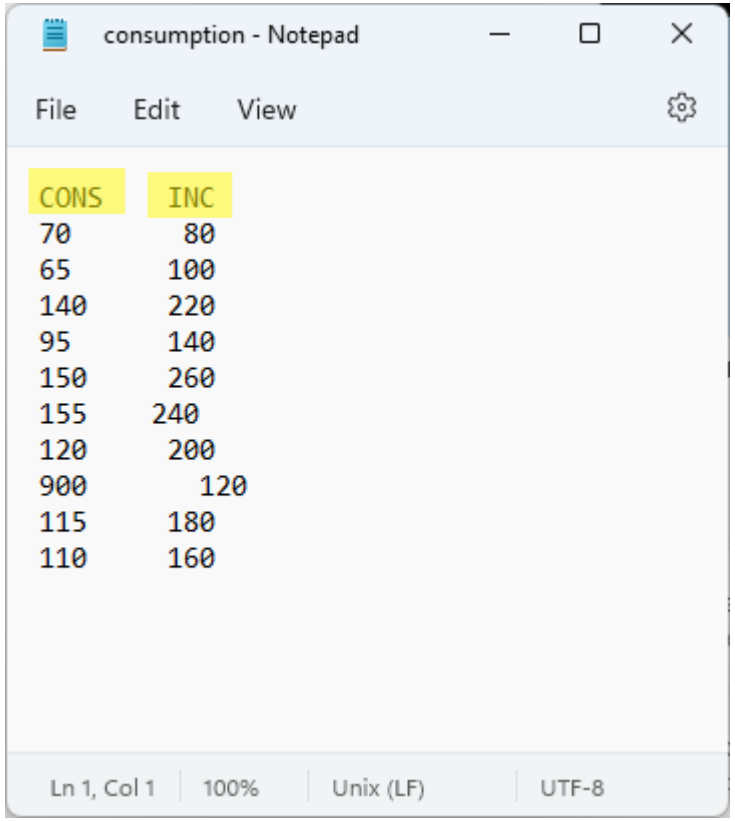
1. The text file `consumption.txt` contains observations on the weekly family consumption expenditure (`CONS`) and income (`INC`) for a sample of 10 families.

# consumption.txt



1. The text file `consumption.txt` contains observations on the weekly family consumption expenditure (`CONS`) and income (`INC`) for a sample of 10 families.

   (a) Read the data into R.

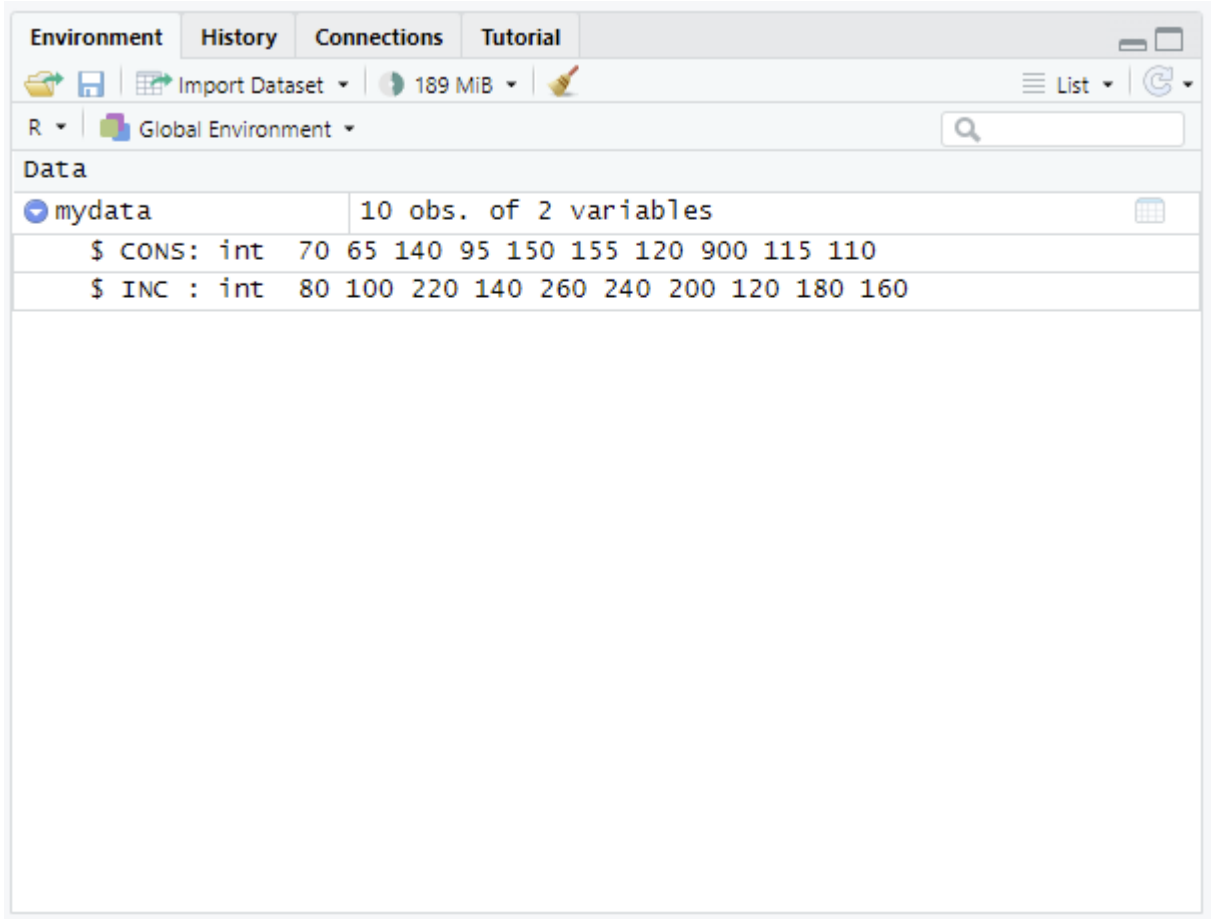
## Set Work Directory

Session > Set Working Directory > To Source File Location

**Solution** The data is loaded using the R command `read.delim`.

```
mydata <- read.delim("consumption.txt", header = TRUE,  sep = "")
```

We use the option `header = TRUE` to inform R that the first line contains variable names, and the option `sep = ""` to indicate that the variables are separated by a space. At the same, we create an R variable `mydata` to store the data.



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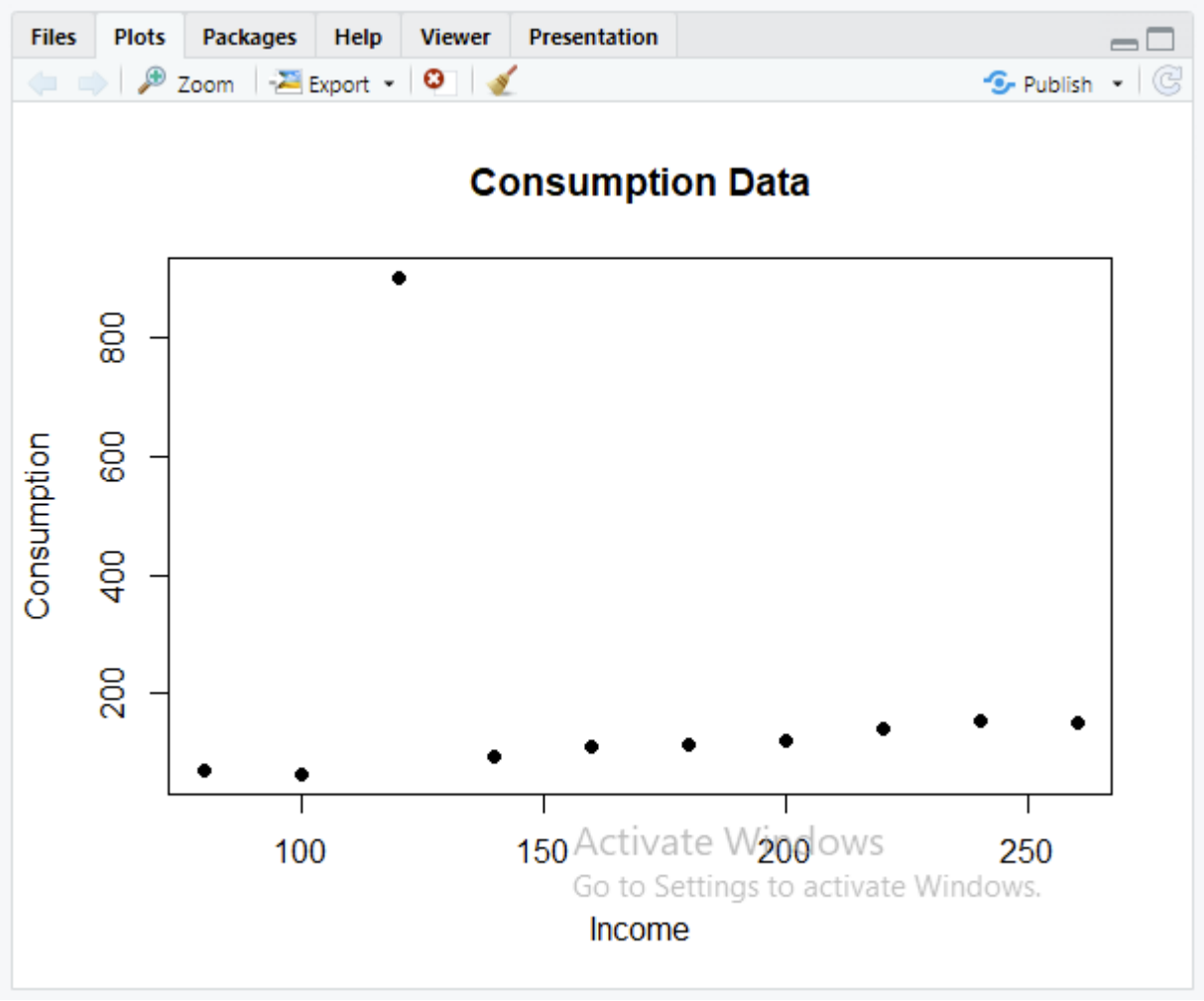
   (a) Read the data into R.

   (b) Draw a scatter diagram of `CONS` against `INC`.

**Solution** The simplest way to draw a scatter gram is to `attach` the data and use the `plot` command.

```
attach(mydata)
plot(INC, CONS, main="Consumption Data",
     xlab="Income", ylab="Consumption", pch=19)
```

The command `plot` has several arguments. The first two are the $X$ and $Y$ variables. In addition, it has options to choose a title (`main`) and labels (`xlab` and `ylab`), as well as the point style (`pch`).



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   (a) Read the data into R.

   (b) Draw a scatter diagram of `CONS` against `INC`.

   (c) On checking the data, you find that your assistant has recorded the weekly consumption expenditure for Family 8 as \$900 instead of \$90. Correct this error and redraw the scatter diagram.

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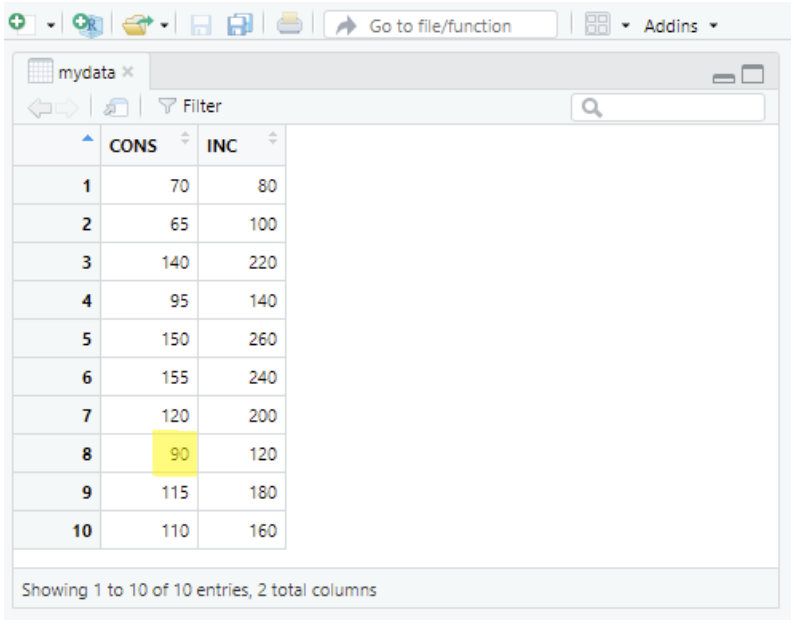
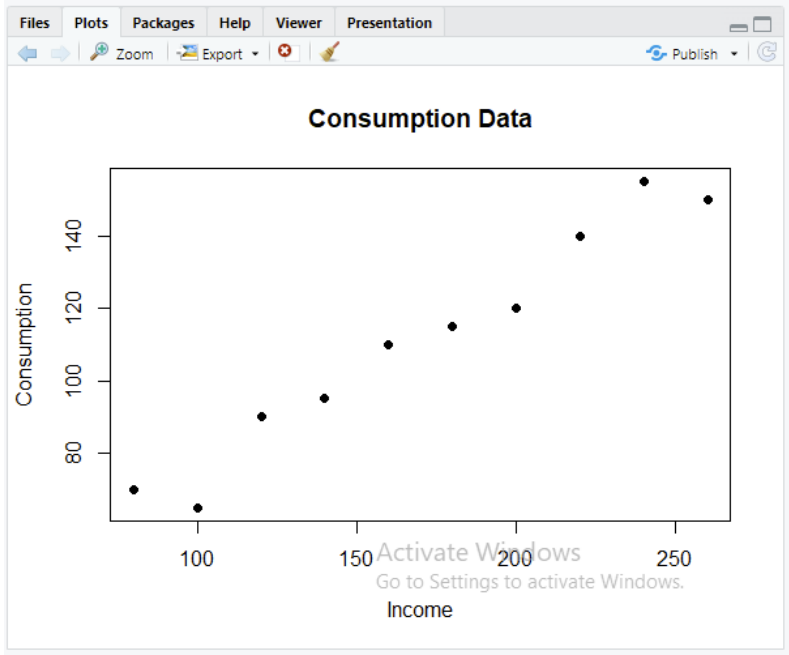
**Solution** The data are in the form of a matrix whose (8,1) element has the error, so we assign the correct value to it. Next, we need to "refresh" the data in memory by "detaching" and "attaching" `mydata` again. Once done, redraw the scatter diagram by repeating the command in part (b).

```
mydata[8,1] <- 90

detach(mydata)
attach(mydata)

plot(INC, CONS, main="Consumption Data",
     xlab="Income", ylab="Consumption", pch=19)
```



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   (d) Compute the mean, median, maximum and minimum values of `INC` and `CONS`.

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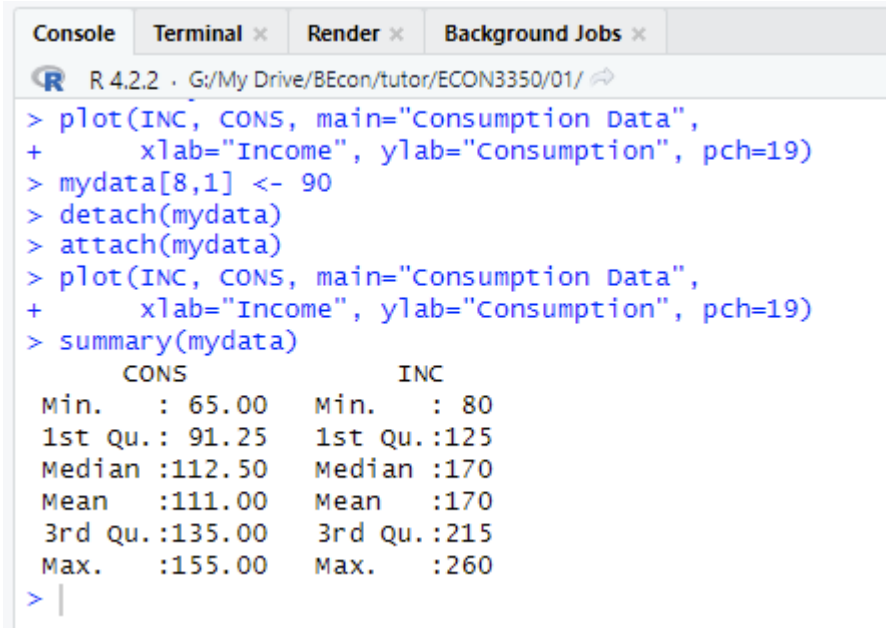
**Solution** All these statistics are neatly summarised by the `summary` command.

```
summary(mydata)
```



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   (e) Compute the correlation coefficient between `CONS` and `INC`. Comment on the result.

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   (d) Compute the mean, median, maximum and minimum values of `INC` and `CONS`.

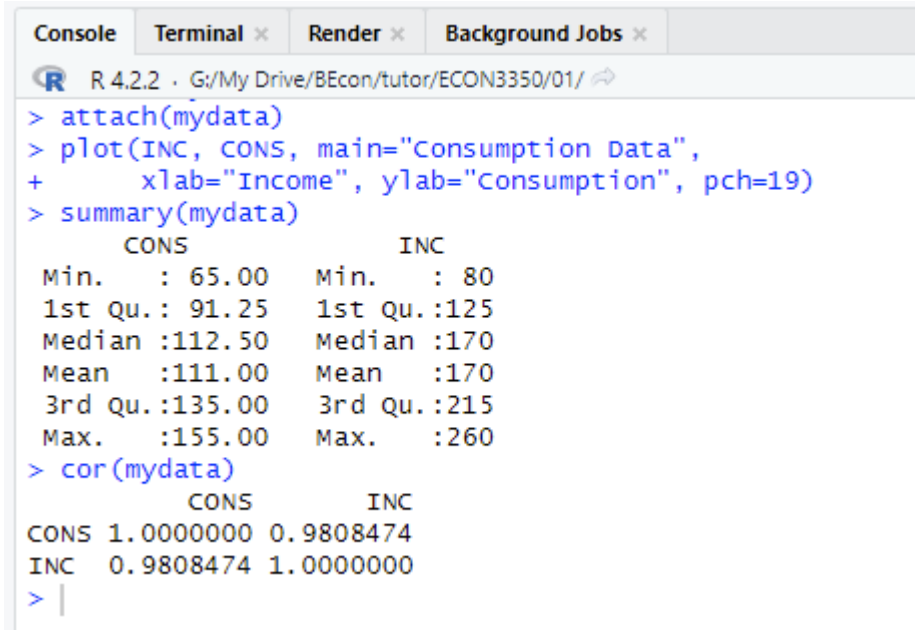
   (e) Compute the correlation coefficient between `CONS` and `INC`. Comment on the result.

**Solution** The command `cor` gives a correlation matrix. The off-diagonal elements are correlation coefficients between the variables indicated in the rows and columns.

```
cor(mydata)
```

```
##             CONS       INC
## CONS 1.0000000 0.9808474
## INC  0.9808474 1.0000000
```

In this example, we have only two variables, which gives only one correlation coefficient (0.981). Since the correlation coefficient is close to (positive) one, consumption and income are moving in the same direction and they are closely related.



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   (a) Read the data into R.

   (b) Draw a scatter diagram of CONS against INC.

   (c) On checking the data, you find that your assistant has recorded the weekly consumption expenditure for Family 8 as \$900 instead of \$90. Correct this error and redraw the scatter diagram.

   (d) Compute the mean, median, maximum and minimum values of INC and CONS.

   (e) Compute the correlation coefficient between CONS and INC. Comment on the result.

   (f) Create the following new variables:

$$\begin{aligned} \texttt{DCONS} &= 0.5\texttt{CONS}, \\ \texttt{LCONS} &= \log(\texttt{CONS}), \\ \texttt{INC2} &= \texttt{INC}^2, \\ \texttt{SQRTINC} &= \sqrt{\texttt{INC}}. \end{aligned}$$

# Intro · RStudio · consumption.txt · fultonfish.def

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   (b) Draw a scatter diagram of `CONS` against `INC`.

   (c) On checking the data, you find that your assistant has recorded the weekly consumption expenditure for Family 8 as \$900 instead of \$90. Correct this error and redraw the scatter diagram.

   (d) Compute the mean, median, maximum and minimum values of `INC` and `CONS`.

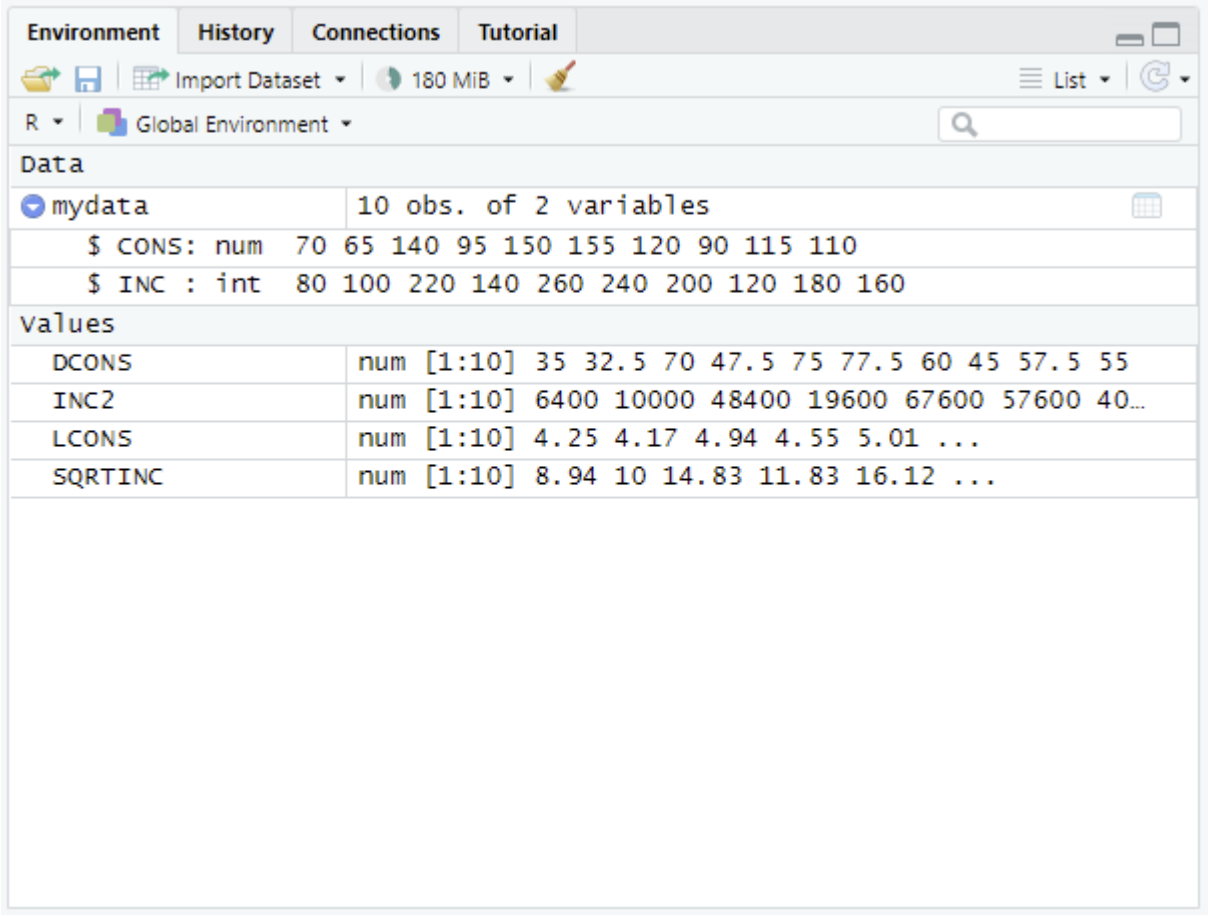
   (e) Compute the correlation coefficient between `CONS` and `INC`. Comment on the result.

   (f) Create the following new variables:

$$\begin{aligned} \texttt{DCONS} &= 0.5\texttt{CONS}, \\ \texttt{LCONS} &= \log(\texttt{CONS}), \\ \texttt{INC2} &= \texttt{INC}^2, \\ \texttt{SQRTINC} &= \sqrt{\texttt{INC}}. \end{aligned}$$

**Solution** Variables are created using either `<-` or `=`. The function `log` applied the "natural logarithm'' transformation.

```
DCONS <- 0.5 * CONS
LCONS <- log(CONS)
INC2 = INC^2
SQRTINC = sqrt(INC)
```



1. The text file `consumption.txt` contains observations on the weekly family consumption expenditure (`CONS`) and income (`INC`) for a sample of 10 families.

   (a) Read the data into R.

   (b) Draw a scatter diagram of `CONS` against `INC`.

   (c) On checking the data, you find that your assistant has recorded the weekly consumption expenditure for Family 8 as \$900 instead of \$90. Correct this error and redraw the scatter diagram.

   (d) Compute the mean, median, maximum and minimum values of `INC` and `CONS`.

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$$\begin{aligned} \texttt{DCONS} &= 0.5\texttt{CONS}, \\ \texttt{LCONS} &= \log(\texttt{CONS}), \\ \texttt{INC2} &= \texttt{INC}^2, \\ \texttt{SQRTINC} &= \sqrt{\texttt{INC}}. \end{aligned}$$

   (g) Delete the variables `DCONS` and `SQRTINC`.

   (h) Delete everything.

1. The text file `consumption.txt` contains observations on the weekly family consumption expenditure (CONS) and income (INC) for a sample of 10 families.

   (a) Read the data into R.

   (b) Draw a scatter diagram of CONS against INC.

   (c) On checking the data, you find that your assistant has recorded the weekly consumption expenditure for Family 8 as \$900 instead of \$90. Correct this error and redraw the scatter diagram.

   (d) Compute the mean, median, maximum and minimum values of INC and CONS.

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   (f) Create the following new variables:

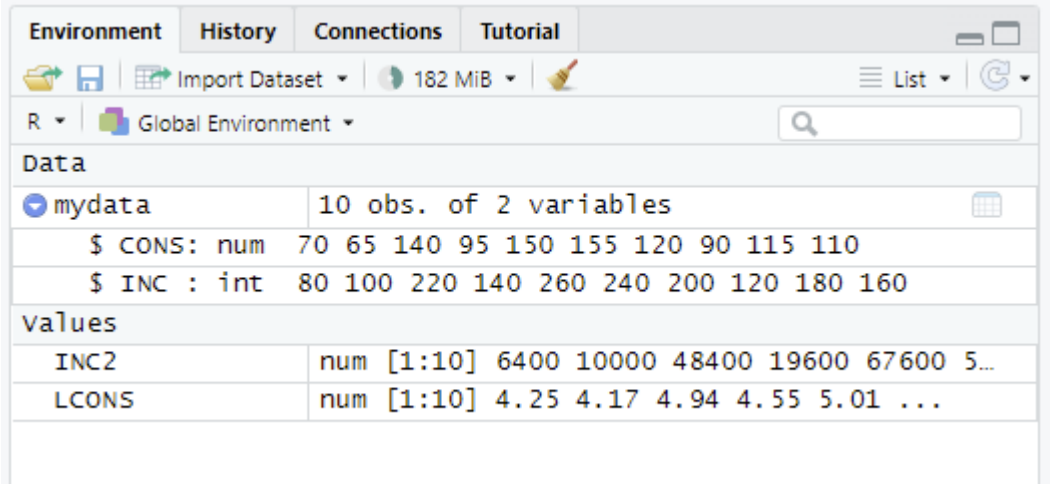
$$\begin{aligned} \texttt{DCONS} &= 0.5\texttt{CONS}, \\ \texttt{LCONS} &= \log(\texttt{CONS}), \\ \texttt{INC2} &= \texttt{INC}^2, \\ \texttt{SQRTINC} &= \sqrt{\texttt{INC}}. \end{aligned}$$

   (g) Delete the variables DCONS and SQRTINC.

   (h) Delete everything.

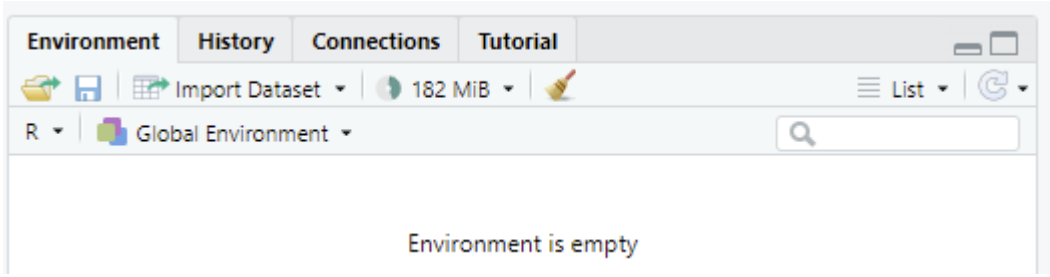
**Solution** Use the `rm` command to delete variables.

```
rm(DCONS, SQRTINC)
```




**Solution** Delete all the variables by passing the output of the `ls` command to `rm`.

```
rm(list = ls())
```



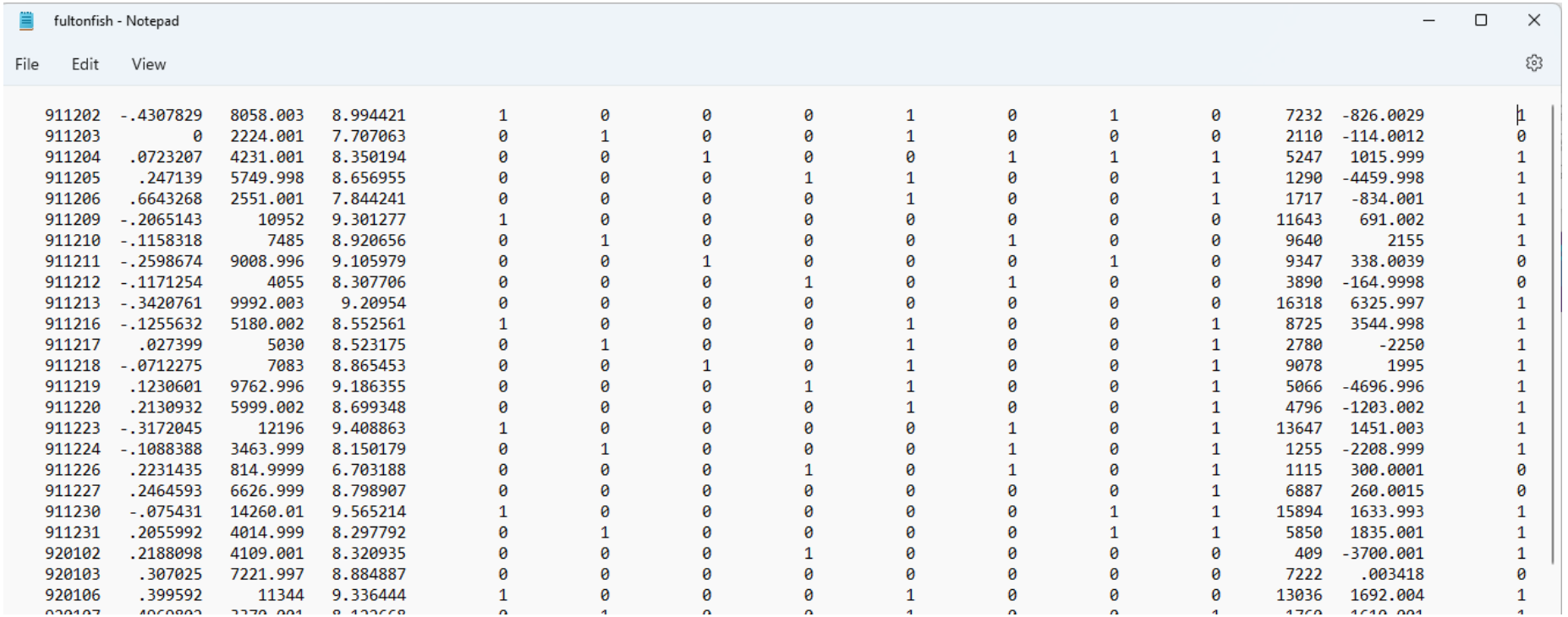
2. At the Famous Fulton Fish Market in New York city, sales of whiting (a type of fish) vary from day to day. Over a period of several months, daily quantities sold (in pounds) were observed. These data are in the file `fultonfish.dat`. Description of the data is in the file `fultonfish.def`. Describe the first four columns.

## fultonfish.dat

Whiting

2. At the Famous Fulton Fish Market in New York city, sales of whiting (a type of fish) vary from day to day. Over a period of several months, daily quantities sold (in pounds) were observed. These data are in the file `fultonfish.dat`. Description of the data is in the file `fultonfish.def`. Describe the first four columns.

fultonfish.dat




```
911202  -.4307829   8058.003   8.994421   1   0   0   0   1   0   1   0   7232  -826.0029   1
911203          0   2224.001   7.707063   0   1   0   0   1   0   0   0   2110  -114.0012   0
911204   .0723207   4231.001   8.350194   0   0   1   0   0   1   1   1   5247   1015.999   1
911205    .247139   5749.998   8.656955   0   0   0   1   1   0   0   1   1290  -4459.998   1
911206   .6643268   2551.001   7.844241   0   0   0   0   1   0   0   1   1717   -834.001   1
911209  -.2065143      10952   9.301277   1   0   0   0   0   0   0   0  11643    691.002   1
911210  -.1158318       7485   8.920656   0   1   0   0   0   1   0   0   9640       2155   1
911211  -.2598674   9008.996   9.105979   0   0   1   0   0   0   1   0   9347   338.0039   0
911212  -.1171254       4055   8.307706   0   0   0   1   0   1   0   0   3890  -164.9998   0
911213  -.3420761   9992.003    9.20954   0   0   0   0   0   0   0   0  16318   6325.997   1
911216  -.1255632   5180.002   8.552561   1   0   0   0   1   0   0   1   8725   3544.998   1
911217    .027399       5030   8.523175   0   1   0   0   1   0   0   1   2780      -2250   1
911218  -.0712275       7083   8.865453   0   0   1   0   1   0   0   1   9078       1995   1
911219   .1230601   9762.996   9.186355   0   0   0   1   1   0   0   1   5066  -4696.996   1
911220   .2130932   5999.002   8.699348   0   0   0   0   1   0   0   1   4796  -1203.002   1
911223  -.3172045      12196   9.408863   1   0   0   0   0   1   0   1  13647   1451.003   1
911224  -.1088388   3463.999   8.150179   0   1   0   0   0   1   0   1   1255  -2208.999   1
911226   .2231435   814.9999   6.703188   0   0   0   1   0   1   0   1   1115   300.0001   0
911227   .2464593   6626.999   8.798907   0   0   0   0   0   0   0   1   6887   260.0015   0
911230   -.075431   14260.01   9.565214   1   0   0   0   0   0   1   1  15894   1633.993   1
911231   .2055992   4014.999   8.297792   0   1   0   0   0   0   1   1   5850   1835.001   1
920102   .2188098   4109.001   8.320935   0   0   0   1   0   0   0   0    409  -3700.001   1
920103    .307025   7221.997   8.884887   0   0   0   0   0   0   0   0   7222    .003418   0
920106    .399592      11344   9.336444   1   0   0   0   1   0   0   0  13036   1692.004   1
```

2. At the Famous Fulton Fish Market in New York city, sales of whiting (a type of fish) vary from day to day. Over a period of several months, daily quantities sold (in pounds) were observed. These data are in the file `fultonfish.dat`. Description of the data is in the file `fultonfish.def`. Describe the first four columns.

   (a) Use R to open the data file and name the series in the first four columns as `date`, `lprice`, `quan` and `lquan`.

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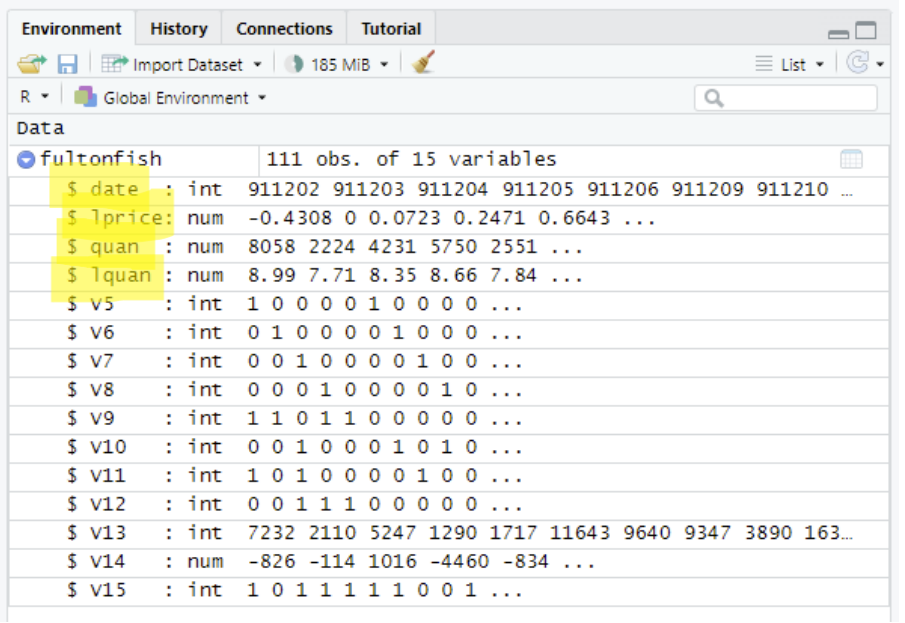
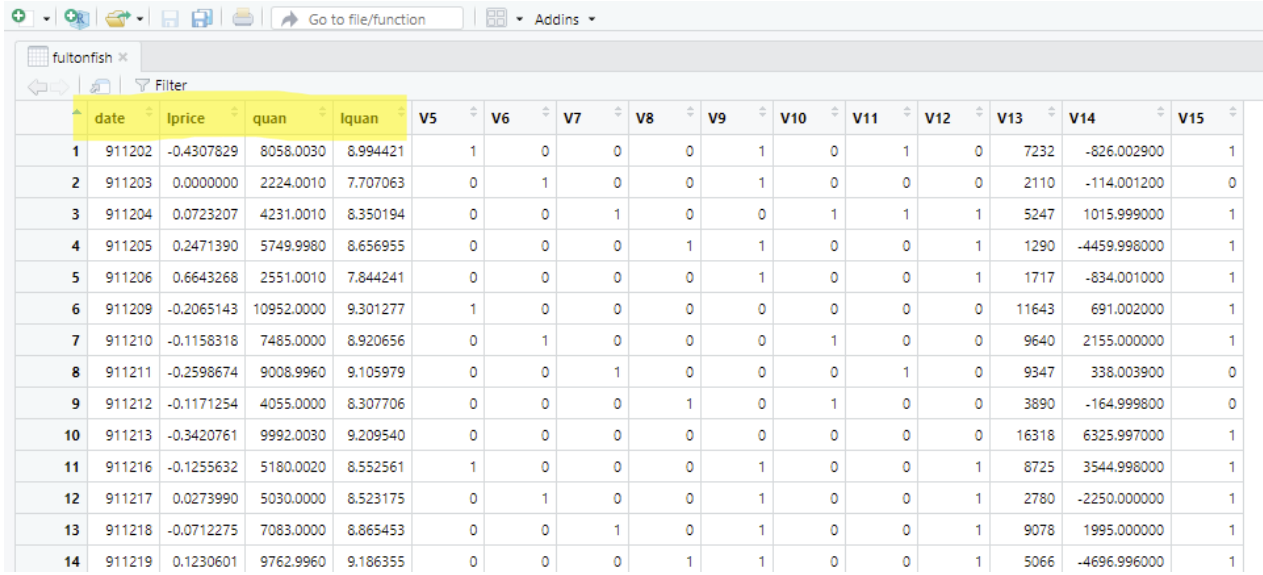
**Solution** R assigns variable names `V1`, `V2`, ... when the variables do not have a name. Assign proper names to the first four variables using the command `colnames`.

```
fultonfish <- read.delim("fultonfish.dat", header = FALSE,  sep = "")
colnames(fultonfish)[1:4] <- c("date", "lprice", "quan", "lquan")
```

The command `colnames` takes an R object as an argument—in this case `fultonfish`. The range in brackets, [1:4], chooses the columns (from the first to the fourth). The command `c` "concatenates" a list of variables.




| | date | lprice | quan | lquan | V5 | V6 | V7 | V8 | V9 | V10 | V11 | V12 | V13 | V14 | V15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 911202 | -0.4307829 | 8058.0030 | 8.994421 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 7232 | -826.002900 | 1 |
| 2 | 911203 | 0.0000000 | 2224.0010 | 7.707063 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 2110 | -114.001200 | 0 |
| 3 | 911204 | 0.0723207 | 4231.0010 | 8.350194 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 5247 | 1015.999000 | 1 |
| 4 | 911205 | 0.2471390 | 5749.9980 | 8.656955 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1290 | -4459.998000 | 1 |
| 5 | 911206 | 0.6643268 | 2551.0010 | 7.844241 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1717 | -834.001000 | 1 |
| 6 | 911209 | -0.2065143 | 10952.0000 | 9.301277 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11643 | 691.002000 | 1 |
| 7 | 911210 | -0.1158318 | 7485.0000 | 8.920656 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 9640 | 2155.000000 | 1 |
| 8 | 911211 | -0.2598674 | 9008.9960 | 9.105979 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 9347 | 338.003900 | 0 |
| 9 | 911212 | -0.1171254 | 4055.0000 | 8.307706 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 3890 | -164.999800 | 0 |
| 10 | 911213 | -0.3420761 | 9992.0030 | 9.209540 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16318 | 6325.997000 | 1 |
| 11 | 911216 | -0.1255632 | 5180.0020 | 8.552561 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 8725 | 3544.998000 | 1 |
| 12 | 911217 | 0.0273990 | 5030.0000 | 8.523175 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 2780 | -2250.000000 | 1 |
| 13 | 911218 | -0.0712275 | 7083.0000 | 8.865453 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 9078 | 1995.000000 | 1 |
| 14 | 911219 | 0.1230601 | 9762.9960 | 9.186355 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 5066 | -4696.996000 | 1 |

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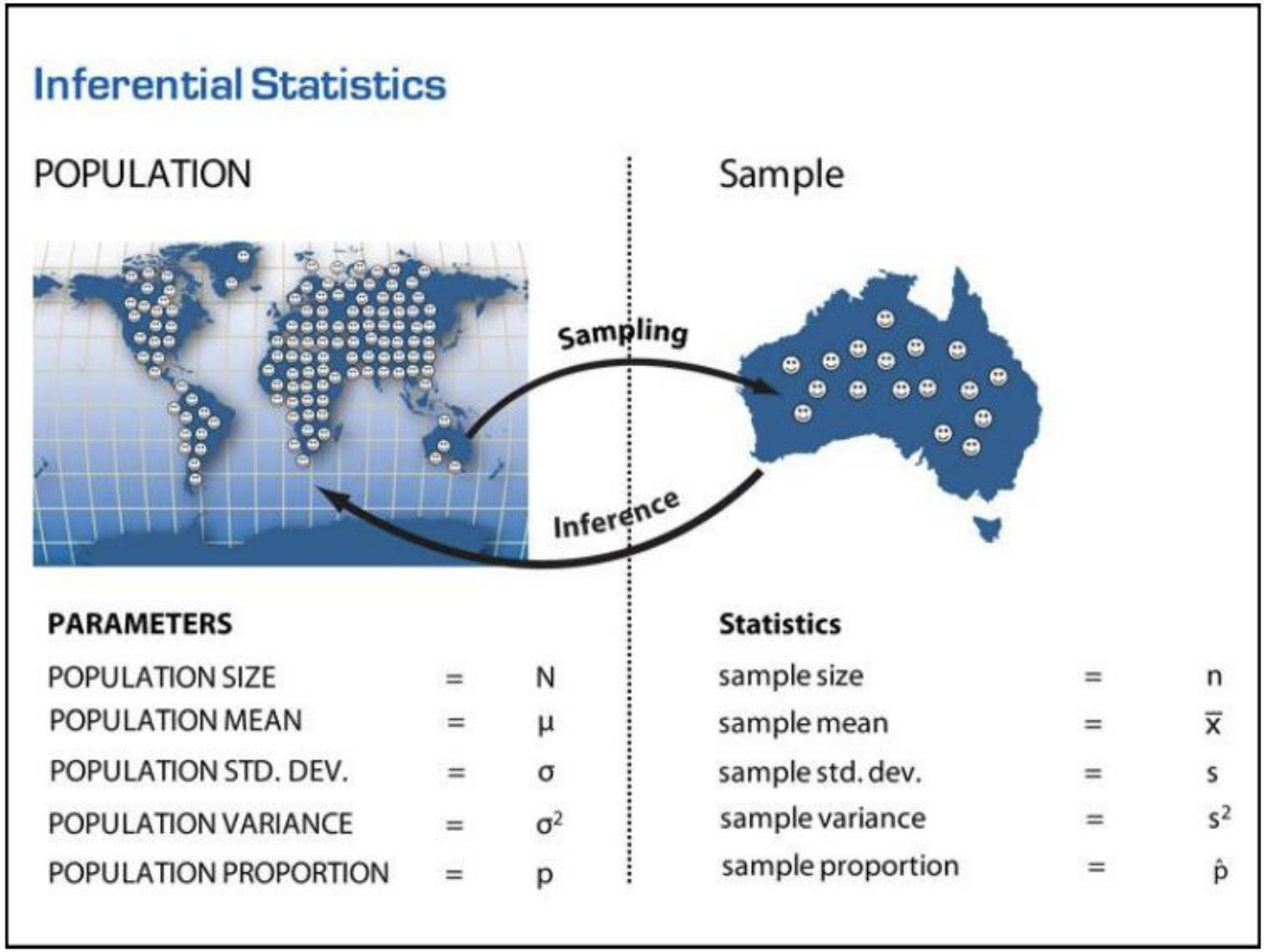
   (b) Compute the sample mean and standard deviation of the quantity sold (`quan`).



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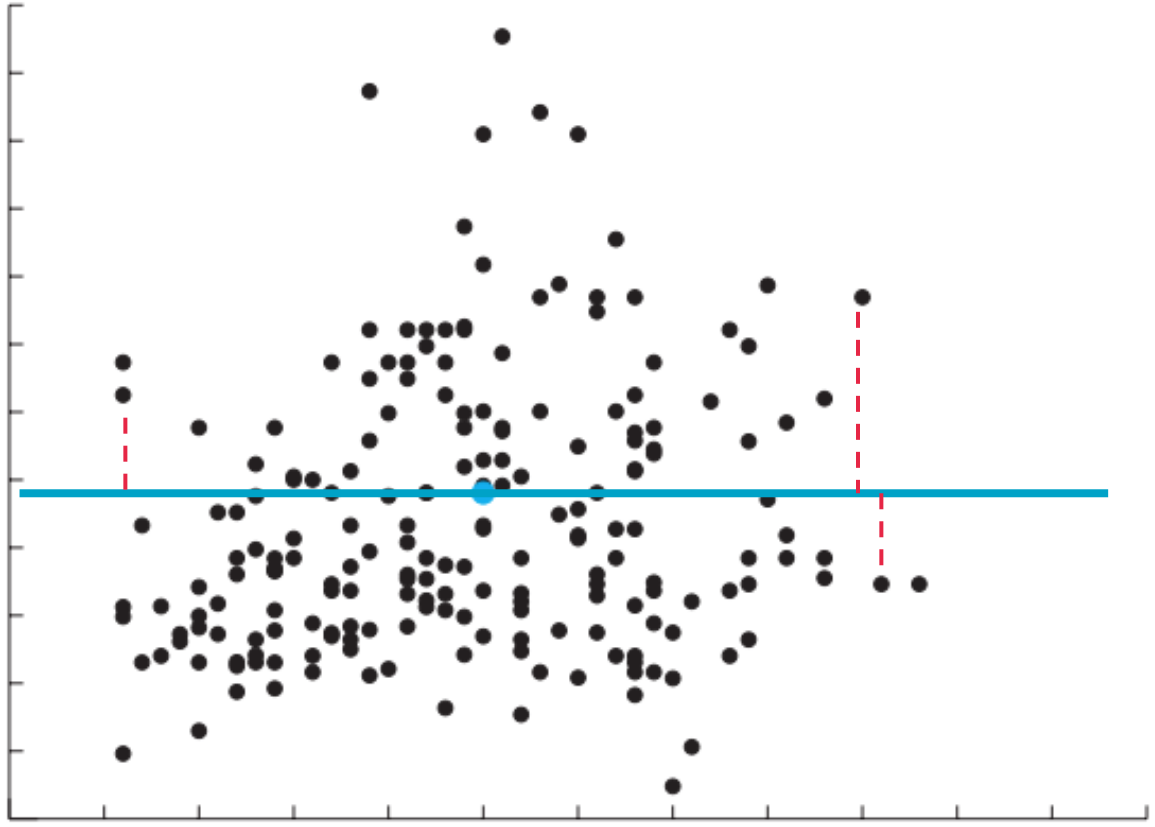

What is the sample mean?
Should I add every observation and divide by the number of observations?

YES!

The bar represents mean →

$$\overline{Y} = \frac{1}{n}\sum_{i=1}^{n} Y_i = \frac{1}{n}(Y_1 + Y_2 + \cdots + Y_n)$$

$$\overline{Y} \xrightarrow{p} \mu_Y.$$

What is the standard deviation?
From ECON1310, you might remember that standard deviation = σ and $\sigma^2$ = variance. So $\sigma = \sqrt{variance}$.

$$\text{Var}(Y) = \frac{1}{N}\sum_{i=1}^{N}(y_i - \mu_Y)^2$$

$$s_Y^2 = \frac{1}{n-1}\sum_{i=1}^{n}(y_i - \overline{y})^2$$

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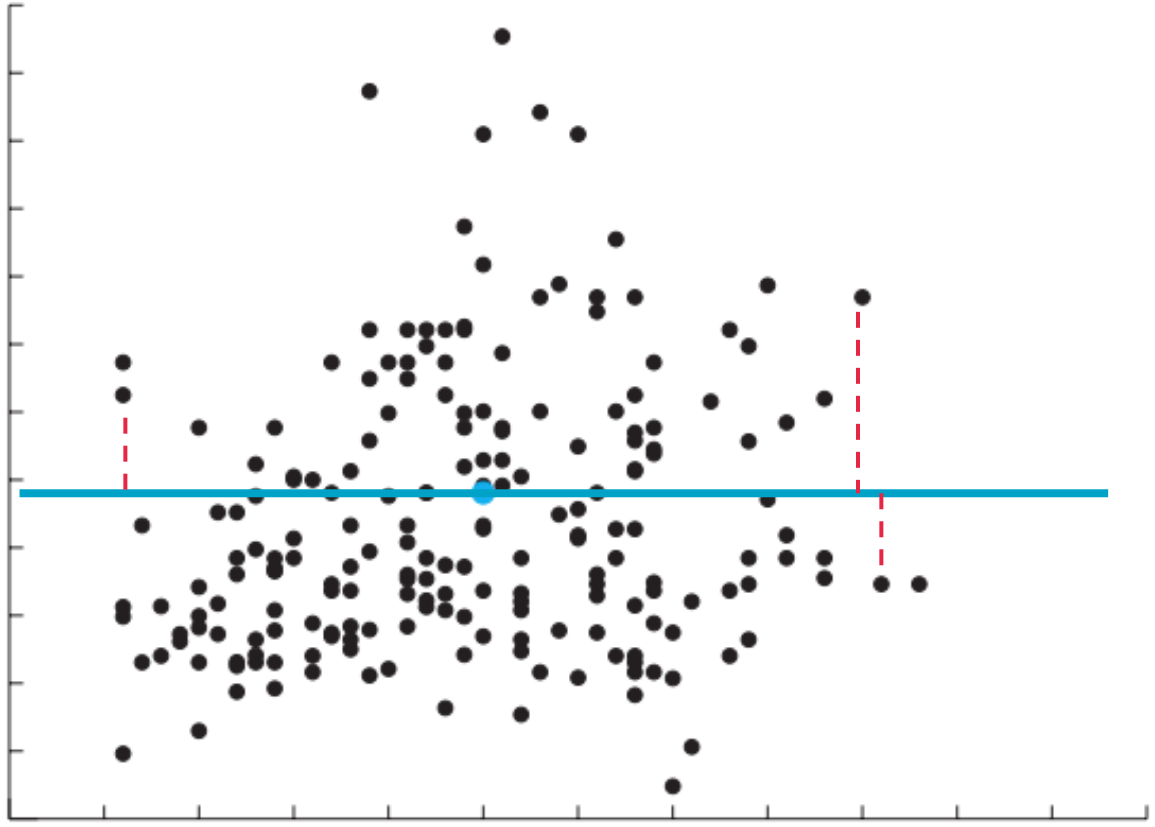


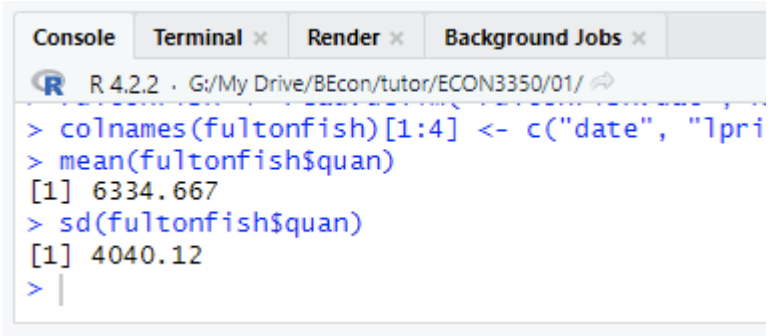
**Solution** This is straightforward using commands `mean` and `sd`.

```
mean(fultonfish$quan)
```

```
## [1] 6334.667
```

```
sd(fultonfish$quan)
```

```
## [1] 4040.12
```



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   (c) Test the null hypothesis that the mean quantity sold is equal to 7,200 pounds a day at the 5% level of significance.

**Five Steps for Hypothesis Testing.**

1. State $H_0$ and $H_1$
2. State the decision rule for the appropriate test statistic and sampling distribution
3. Calculate the test statistic
4. Make a decision (reject $H_0$ or do not reject $H_0$)
5. State a conclusion

**Note:**
steps 1 and 2 are prior to any sample information.

26

Step 1: State $H_0$ and $H_1$

$H_0$: μ = 7,200

$H_1$: μ ≠ 7,200

Step 2: Decision rule

Reject $H_0$ if $|t_{calc}| > t_{crit} = t_{\alpha/2,n-1} = t_{0.025,110} = 1.98$

Step 3: Calculate $t_{calc}$

$$t_{calc} = \frac{\bar{Y} - \mu}{s_{\bar{Y}}} = \frac{\bar{Y} - \mu}{\frac{s}{\sqrt{n}}} = \frac{6334.67 - 7200}{\frac{4040.12}{\sqrt{111}}} = -2.2566$$

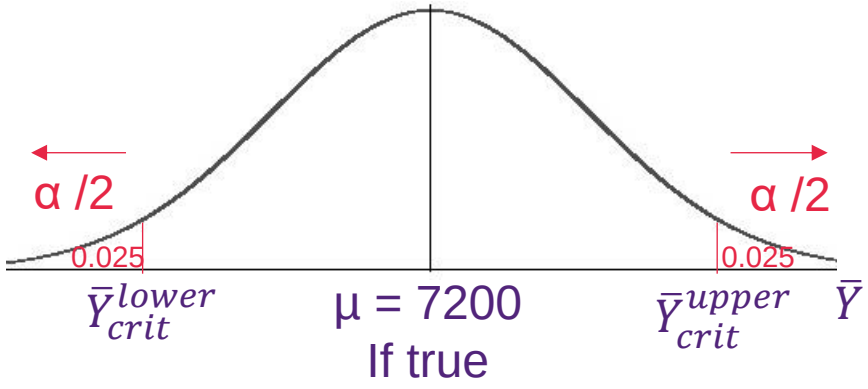
Step 4: Make a decision

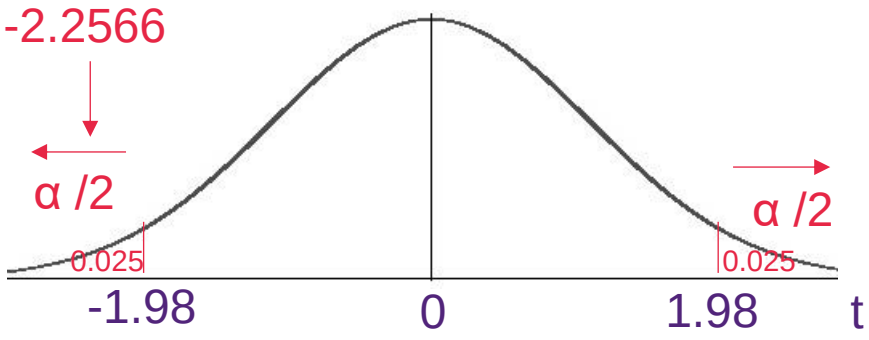
$|t_{calc}| > t_{crit}$ → |-2.26| > 1.98 → Reject $H_0$.

Step 5: Conclusion

There is sufficient evidence to suggest that the mean quantity sold is not equal to 7,200 pounds a day at the 5% level of significance.

Rejection regions



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   (b) Compute the sample mean and standard deviation of the quantity sold (`quan`).

   (c) Test the null hypothesis that the mean quantity sold is equal to 7,200 pounds a day at the 5% level of significance.

**Solution** This is straightforward using the command `t.test`.

```
t.test(fultonfish$quan, mu = 7200)

##
##  One Sample t-test
##
## data:  fultonfish$quan
## t = -2.2566, df = 110, p-value = 0.02601
## alternative hypothesis: true mean is not equal to 7200
## 95 percent confidence interval:
##  5574.717 7094.617
## sample estimates:
## mean of x
##  6334.667
```

**Five Steps for Hypothesis Testing.**

1. State $H_0$ and $H_1$
2. State the decision rule for the appropriate test statistic and sampling distribution
3. Calculate the test statistic
4. Make a decision (reject $H_0$ or do not reject $H_0$)
5. State a conclusion

**Note:**
steps 1 and 2 are prior to any sample information.

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Step 1: State $H_0$ and $H_1$

$H_0$: μ = 7,200

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Reject $H_0$ if $|t_{calc}| > t_{crit} = t_{\alpha/2,n-1} = t_{0.025,110} = 1.98$

Step 3: Calculate $t_{calc}$

$$t_{calc} = \frac{\bar{Y} - \mu}{s_{\bar{Y}}} = \frac{\bar{Y} - \mu}{\frac{s}{\sqrt{n}}} = \frac{6334.67 - 7200}{\frac{4040.12}{\sqrt{111}}} = -2.2566$$

Step 4: Make a decision

$|t_{calc}| > t_{crit}$ → |-2.26| > 1.98 → Reject $H_0$.

Step 5: Conclusion

There is sufficient evidence to suggest that the mean quantity sold is not equal to 7,200 pounds a day at the 5% level of significance.

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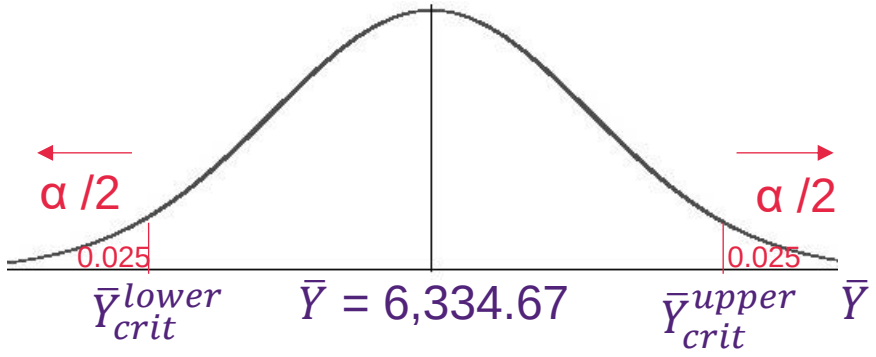
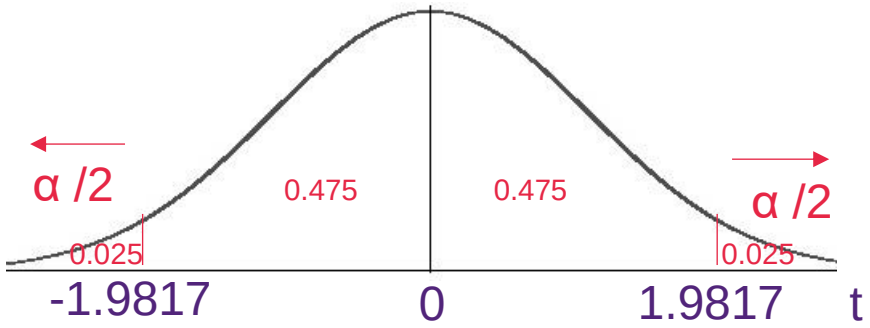
   (d) Construct the 95% confidence interval for part (c).

## Confidence interval



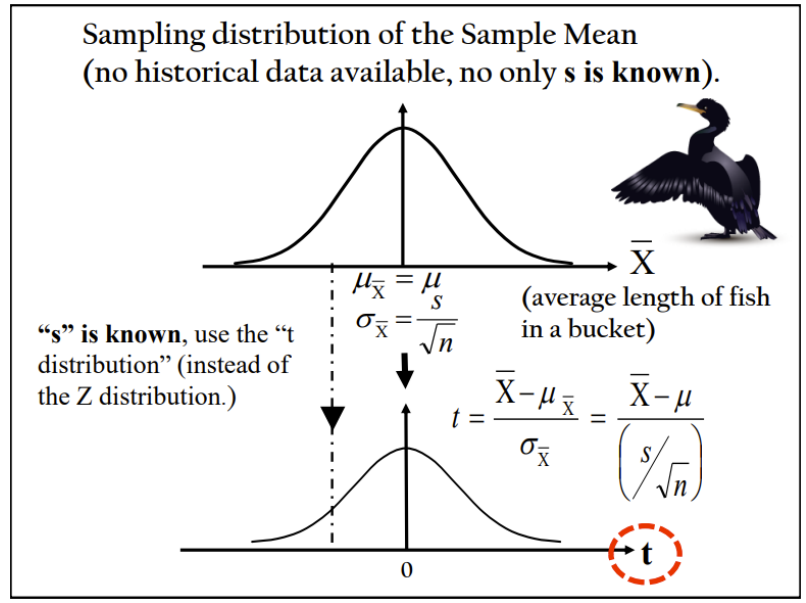




$$\bar{Y} \pm t_{\alpha/2,\,df} * s_{\bar{Y}} =$$

$$\bar{Y} \pm t_{\alpha/2,\,df} * \frac{s}{\sqrt{n}} =$$

$$6{,}334.67 \pm 1.9817 * \frac{4040.12}{\sqrt{111}} =$$

$$5{,}574.72 < \mu < 7{,}094.62$$




**Confidence Interval Estimate for μ, (σ unknown, and only have s).**

**Lower limit:** $\bar{X} - t_{\alpha/2,\,n-1}\frac{s}{\sqrt{n}}$

**Upper limit:** $\bar{X} + t_{\alpha/2,\,n-1}\frac{s}{\sqrt{n}}$

where $t_{\alpha/2,\,n-1}$ is the critical value $t_{crit}$ of the t distribution with:

- n -1 degrees of freedom
- an area of α/2 in **each** tail
- t distribution assumptions must be satisfied

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Console | Terminal | Render | Background Jobs

R 4.2.2 · G:/My Drive/BEcon/tutor/ECON3350/01/

```
> t.test(fultonfish$quan, mu = 7200)

        One Sample t-test

data:  fultonfish$quan
t = -2.2566, df = 110, p-value = 0.02601
alternative hypothesis: true mean is not equal to 7200
95 percent confidence interval:
 5574.717 7094.617
sample estimates:
mean of x
 6334.667

>
```

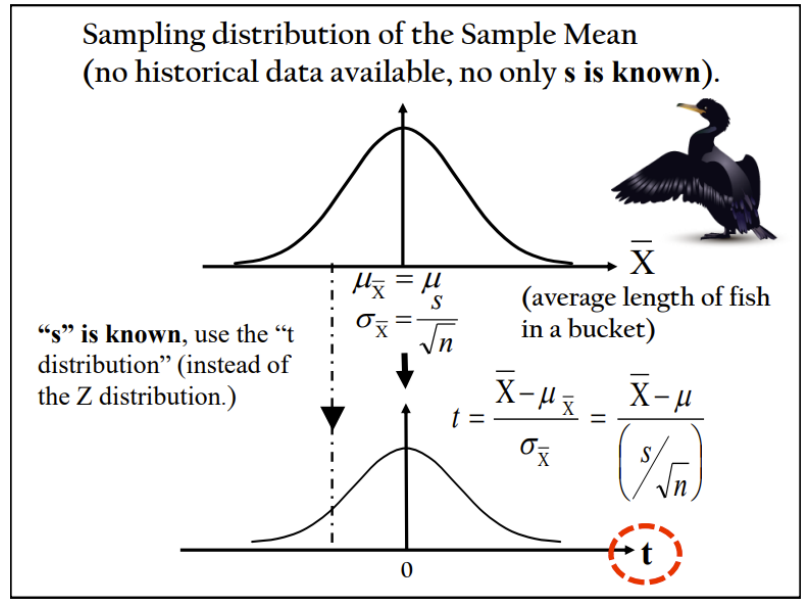
$$\bar{Y} \pm t_{\alpha/2,\,df} * s_{\bar{Y}} =$$

$$\bar{Y} \pm t_{\alpha/2,\,df} * \frac{s}{\sqrt{n}} =$$

$$6{,}334.67 \pm 1.9817 * \frac{4040.12}{\sqrt{111}} =$$

$$5{,}574.72 < \mu < 7{,}094.62$$

All the necessary information is available form the output of the `t.test` command. Indeed, the confidence interval itself is included in the output!




**Confidence Interval Estimate for μ, (σ unknown, and only have s).**

**Lower limit:** $\bar{X} - t_{\alpha/2,\,n-1}\frac{s}{\sqrt{n}}$

**Upper limit:** $\bar{X} + t_{\alpha/2,\,n-1}\frac{s}{\sqrt{n}}$

where $t_{\alpha/2,\,n-1}$ is the critical value $t_{crit}$ of the t distribution with:

- n -1 degrees of freedom
- an area of α/2 in **each** tail
- t distribution assumptions must be satisfied

2. At the Famous Fulton Fish Market in New York city, sales of whiting (a type of fish) vary from day to day. Over a period of several months, daily quantities sold (in pounds) were observed. These data are in the file `fultonfish.dat`. Description of the data is in the file `fultonfish.def`. Describe the first four columns.

   (a) Use R to open the data file and name the series in the first four columns as `date`, `lprice`, `quan` and `lquan`.

   (b) Compute the sample mean and standard deviation of the quantity sold (`quan`).

   (c) Test the null hypothesis that the mean quantity sold is equal to 7,200 pounds a day at the 5% level of significance.

   (d) Construct the 95% confidence interval for part (c).

   (e) Plot `lprice` against `lquan` and label the variable `lprice` as "log(Price) of whiting per pound" and `lquan` as "log(Quantity)". Then, comment on the nature of the relationship between these two variables.

**Solution** Generate the plot the same way as in Question 1, part (b).

```
attach(fultonfish)
plot(lquan, lprice,
     main = "Log Price and Log Quantity",
     xlab="log(Quantity)",
     ylab="log(Price) of whiting per pound",
     pch=19)
```

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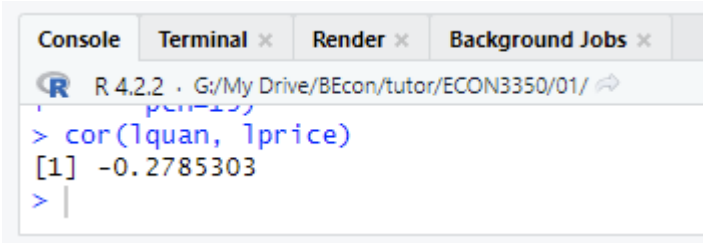



Conceptually, we expect price and quantity to be negatively related, but there does not to appear to be a clear relationship between price and quantity in this data. We can investigate it further by computing the sample correlation.

```
cor(lquan, lprice)
```

```
## [1] -0.2785303
```

The correlation coefficient is slightly negative but not particularly strong. Does this mean demand for whiting is not very affected by prices?

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   (e) Plot `lprice` against `lquan` and label the variable `lprice` as "log(Price) of whiting per pound" and `lquan` as "log(Quantity)". Then, comment on the nature of the relationship between these two variables.

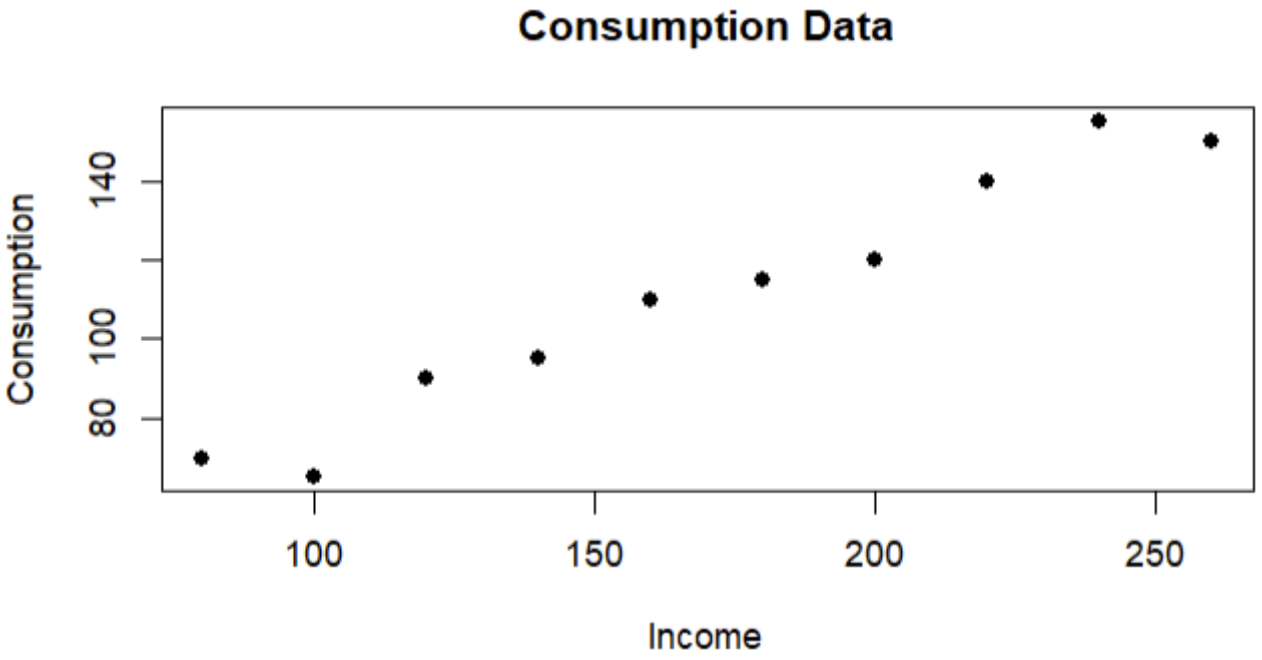
   (f) Save this workfile to any folder on any drive.

**Solution** Save the entire workspace in `RData` format using the `save` command in combination with the `ls` command.

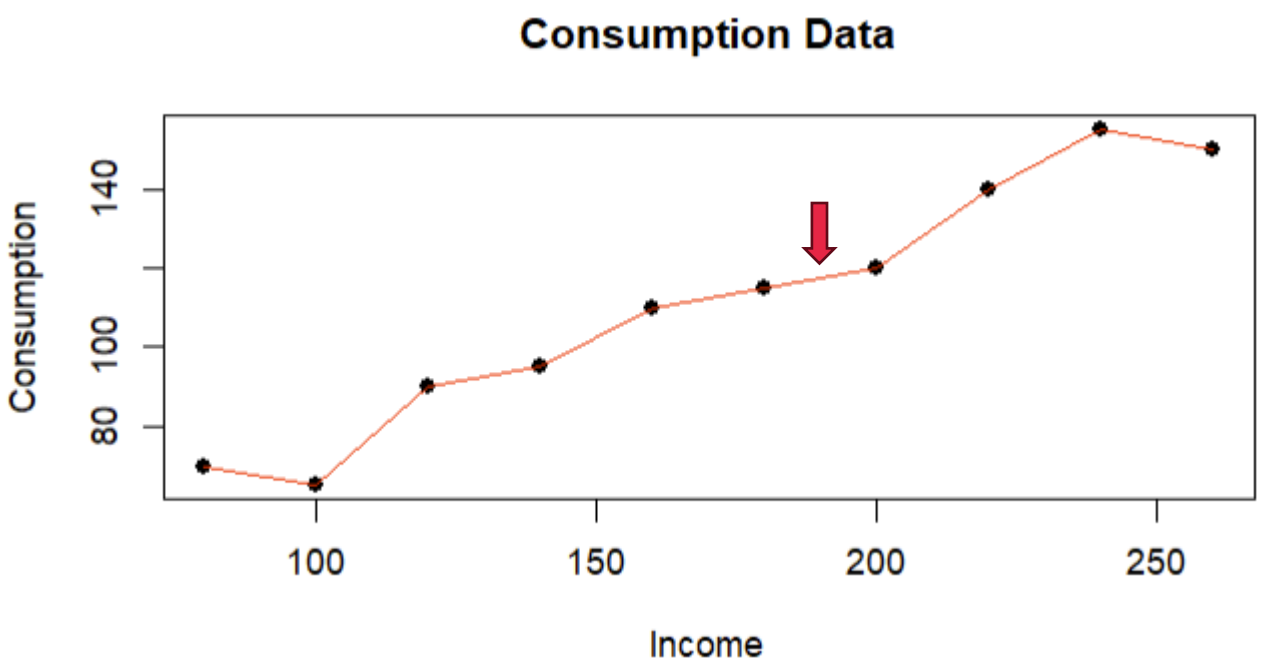
```
save(list = ls(all = TRUE), file = "tuturial01.RData")
```

# Data vs DGP (Data Generating Process)

This is the data from consumption.txt

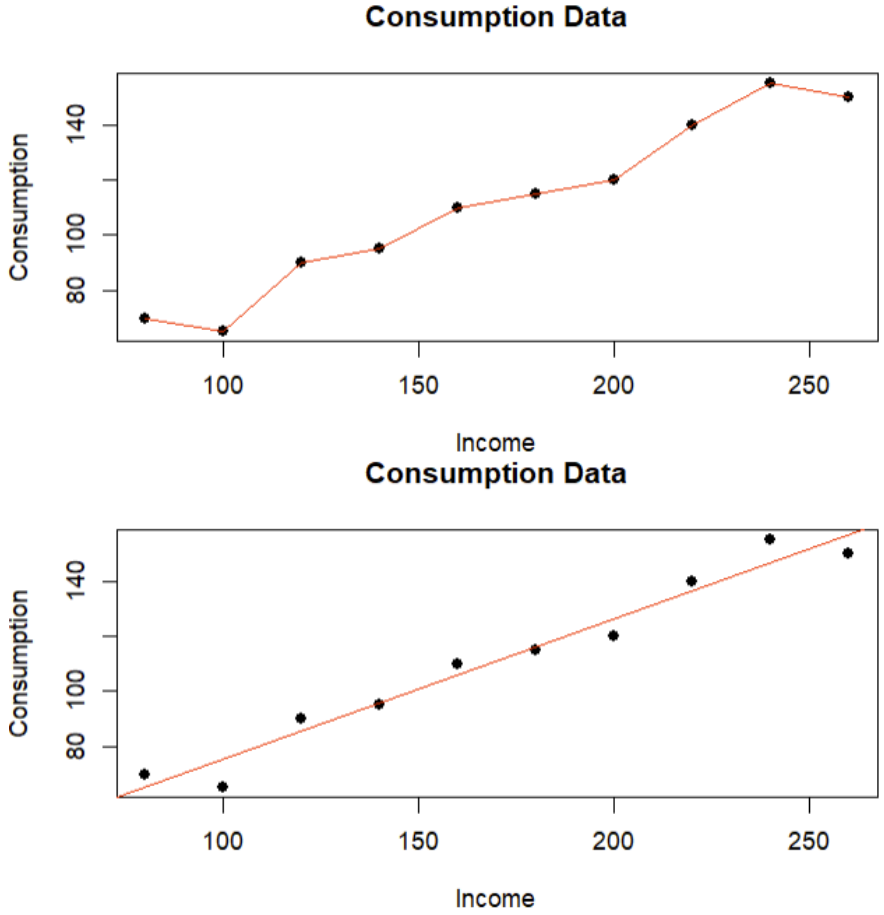



Is this point part of the data?

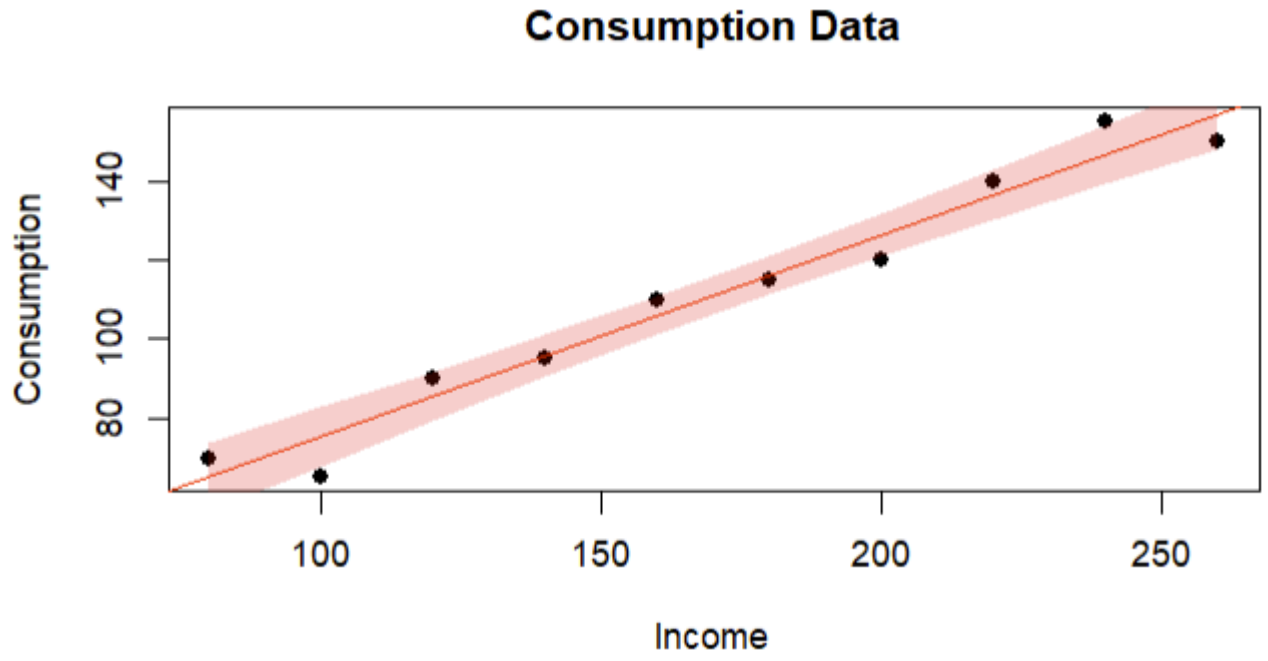


# DGP ➡ Uncertainty (2 types)

Specification uncertainty (between models)




Estimation uncertainty (within each model)



# Let's download the script for this tutorial.

- Copy the code from Github,
  - https://github.com/tavaresgarcia/teaching
- Paste the code in a new script in RStudio,
- Save the script in the same folder as the data.

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AUSTRALIA
CREATE CHANGE

# Thank you


## Francisco Tavares Garcia

Academic Tutor | School of Economics

tavaresgarcia.github.io


**Reference**


Tsay, R. (2010). Analysis of Financial Time Series, 3rd Edition, John Wiley & Sons.