**Foundations of R Software**
**Prof. Shalabh**
**Department of Mathematics and Statistics**
**Indian Institute of Technology, Kanpur**

**Introduction**
**Lecture - 05**
**Introduction to R Studio**

Hello friends. Welcome to the course Foundations of R Software and you may recall that in the last lecture we initiated a discussion on the use of some external software to work in the R software. And in that discussion, we had talked about a software whose name is R Studio and I had requested you that you please download it on your computer and install it. And today in this lecture we are going to understand the working of R studio. And I will try my best to give you a good idea about the basic functionalities which are available in the R studio. Well, there are many many things which are available in the R studio and it is a very user friendly software. So, I am sure that in case if I try to tell you some basic features after that it should not be very difficult for you to understand the remaining features. And as I said earlier R studio is only a helping hand. You can say in very simple words that R studio is a good friend of R software.

So, in case if you want to do any analysis or do any computation, programming in the R studio, then it will become more convenient for you to work in R studio than in R software, but I would repeat here once again. That after this lecture I will come back to the R software and I would like to work only inside the R GUI window or the R console ok. So, let us begin this lecture and we try to understand what is this R studio ok

(Refer Slide Time: 02:05)



**Installing R Studio**

Click on Download.
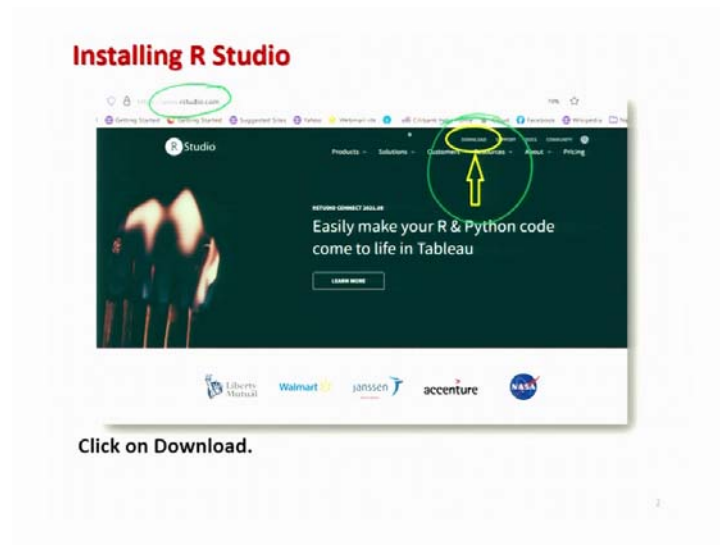
So, in the last lecture, I had given you this slide and where I had told you that from this website r studio dot com. You can download this software R studio by going into this section over here.

(Refer Slide Time: 02:18)



**Installing R Studio**

Download and double click on the downloaded file.
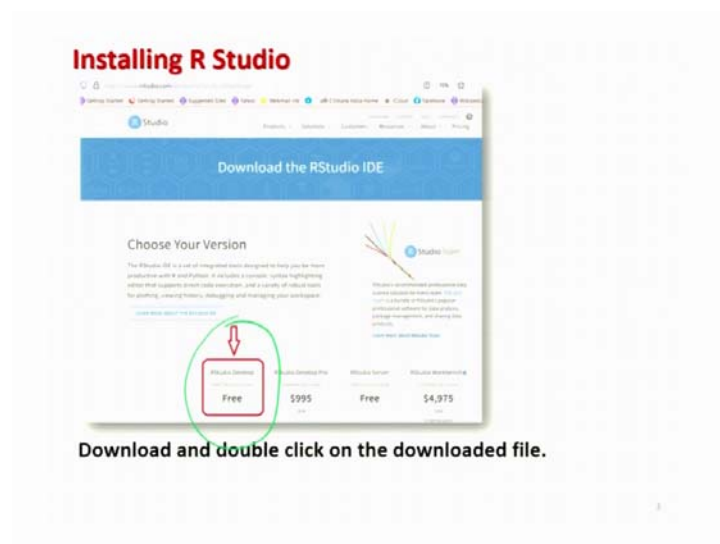
And then finally, downloading the software from this one this is for the desktop and similarly you can go for other platforms also if you wish. And I am looking forward for the free version of the R Studio software.

And once again before going into the details I would like to clarify that I am not trying at all to give an advertisement for this R Studio. I am not saying at all that well this is one of the software and just as an example I have taken this software to demonstrate that how an external software can help in the working of R software, ok.
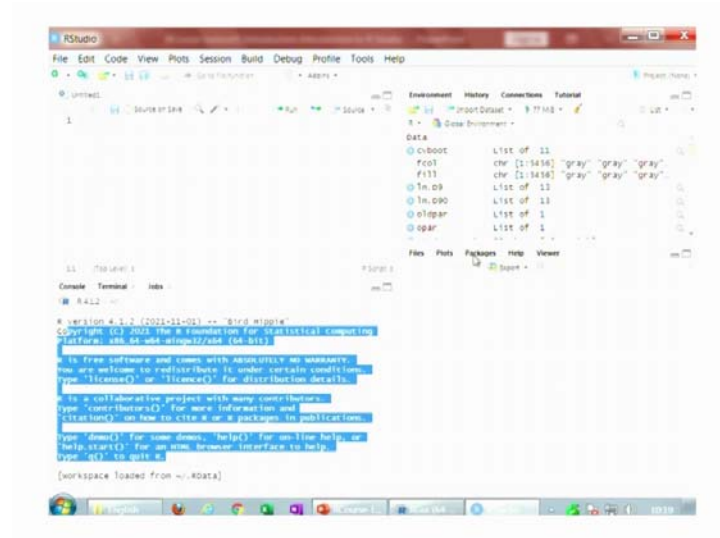
(Refer Slide Time: 02:57)
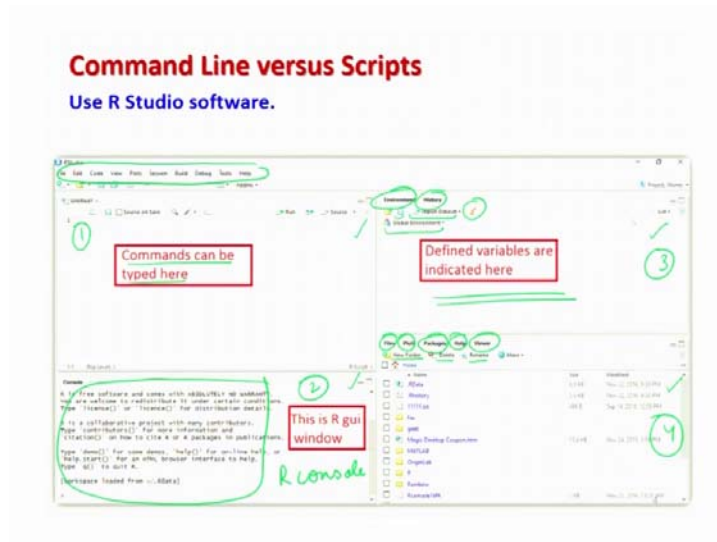


So, now, as soon as you open this software you will find here this type of structure which I have shown you here. There are going to be some windows like this one, this one, this one and this one. So, before I try to explain you the functionalities of this software and functionalities of these windows, let me try to show you this software and then you will have more confidence and then you can have a look.
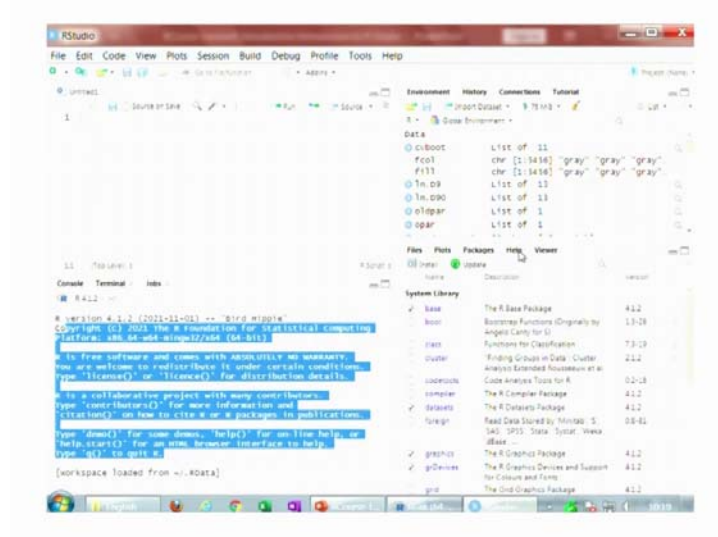
(Refer Slide Time: 03:34)
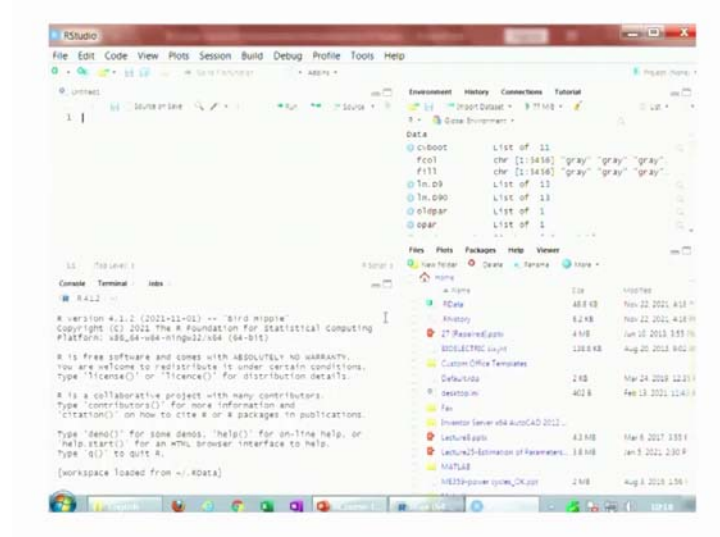


So, this software on my computer and if I start it will look like this. So, you can see here if I try to use my cursor here. You can see where I am moving this is my first window. Then secondly, you can see here I here I am trying to highlight, this is my second window then I am trying to highlight here, this is my here third window and then here I am trying to move here like here say files, plots, packages, help etc.
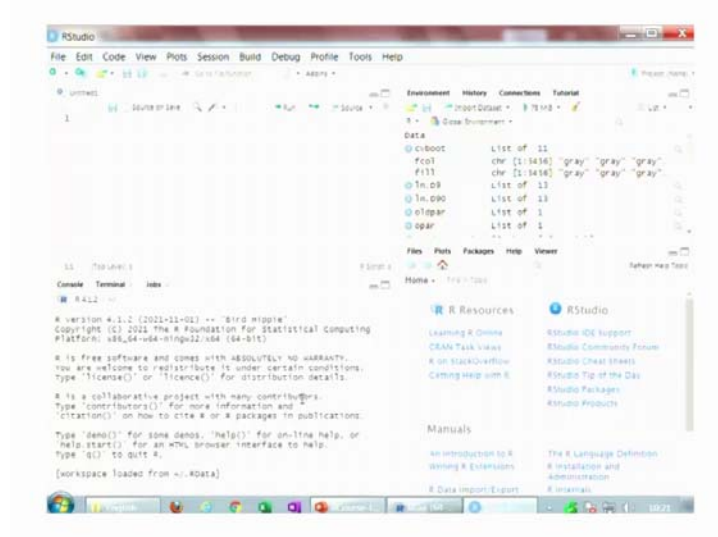
(Refer Slide Time: 04:02)

(Refer Slide Time: 04:03)



(Refer Slide Time: 04:04)



So, this is my fourth window. So, now, what I will do that I will try to choose one window at a time. And then I will try to explain you the basic functionalities of this R studio software, right.

So, now you can actually see. This screen and this screen, they have the same screenshot and yeah you can also open it on your computer and can see whether this is matching with the this screenshot or not. That is not difficult to follow, ok. So, now, if you try to

see here this is your here window number 1. If I call it window number 1. So, this is the place where you are going to type all the commands, right.

And if you try to see here, here there is a menu bar which has all the standard functions like s file, edit, code, view etc. etc. And then this is the place here where you are going to type all the basic commands and if you try to identify here what is this? Means if you try to compare this one with the window in the software, what do you observe here? Can you see here? What is this window? And then if you try to see the R software, the R software look like this. This is your R console.

(Refer Slide Time: 05:36)
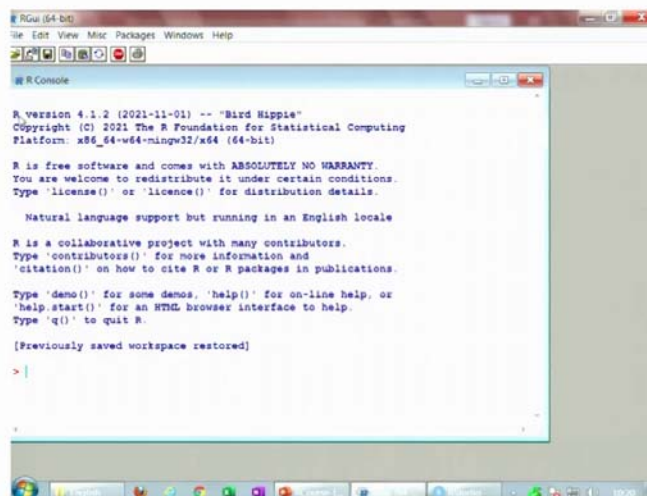


So, if you try to see in the R Studio software, this window is simply your R console, right. So, that is what I am trying to show you here. That this is here simply here R console. So, you can identify it. Now, this is here, let me call window number 2 and this is here suppose window number 3. So, you can see here there are some option like environment, history and then there is a symbol here like as here brush and then it is written import data set then save global environment etc.

So, this is the place where whenever you try to define any variable or you try to give the values to those variable they are stored here. So, the advantage is that you can see what we have done in the past and all those values variables etc. will be there. Well, I will try to take all these windows one by one and I will try to explain you in more detail, but here

I just want to give you a brief overview. And then in the window number here 4 you can see here there has option like here file, plots, packages, help, viewer etc. and then new folder, delete, rename etc. So, these are the four windows now I will try to take up these four windows one by one.

(Refer Slide Time: 07:13)



**Command Line versus Scripts**

Suppose we want to use following three functions:

Type them.
`library(MASS)`
`attach(bacteria)`
`fix(bacteria)`

Suppose we want to run only function: `library(MASS)`

Highlight it and click on Run

Then we get....

And I will try to give you some more details right. Suppose my objective is that I want to execute these three functions, right. Now, you know the meaning of this syntax commands and some of them you might not be knowing it, but I will try to explain you in the forthcoming lectures. So, if you try to see here the first command now you know this is library MASS; that means, you want to upload the library whose name is MASS.

And then you are trying to attach a data set whose name is bacteria. So, this bacteria data set is available inside this package MASS. And then you want to edit it. So, you want to write here fix bacteria. So, now, we had learnt in the earlier lecture that if you want to execute these commands in the R console then you can open an text editor and then you can highlight these commands and then press here control R.

Now, the same thing I would like to do in the R Studio software also.

(Refer Slide Time: 08:26)
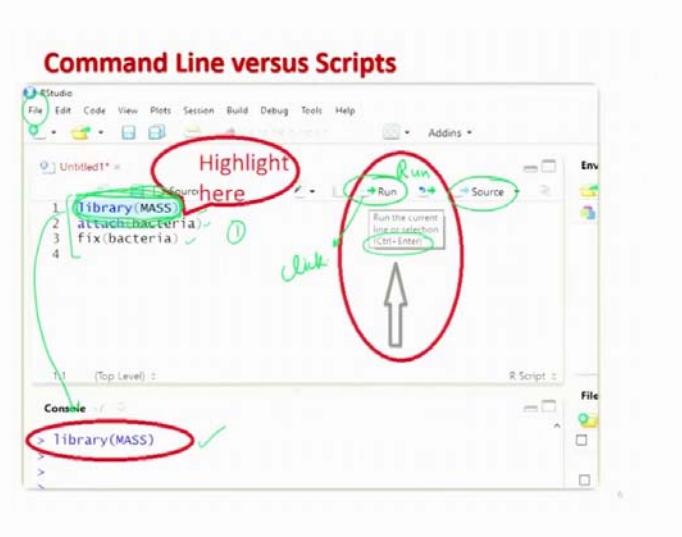


So, now, how to get it done I am really going to show you. So, now, I am simply going to show you here. What happens in the window number 1. This is my window number 1 and if you try to see here I have written here these three commands: library, MASS, attach bacteria and fix bacteria. So, in order to execute these commands just like what you have done in the case of R console that you used to highlight it and then used you used to press the buttons control and R.

Now, I am saying that in the R Studio software you simply highlight; suppose if you want to execute this command library MASS. So, you highlight and then you see here there is a button here where it is written Run R u n Run. You just try to come here and then try to click here. And then what will happen you can see in the console, this command is executed and you can see here this is here library MASS, right. And if you do not want to press here Run then you can also highlight this library MASS and you can press here control plus enter. Means you press the control key and then you press the enter key and this command will be executed, ok. So, this is the function of the window number 1 and here you will see that there is a option of your file and then if you try to open it there will be different options which are the standard option which in most of are available the software, right. And then here you can see there is here another command here source; that means, if you want to attach your program and you want to source it then you can press over here.

8

And, but before going into this detail let me try to show you here in the R console itself. So, what I am doing here I am simply trying to copy these commands so, that I can save some time.

(Refer Slide Time: 10:38)
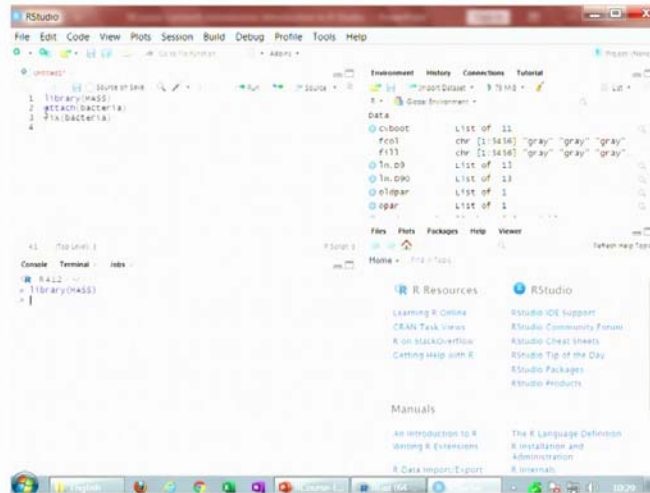


And now, I am coming to here R Studio. And yeah I am trying to paste it here. So, I can now clear my R GUI window. So, that you can see very clearly. So, for that we have the same command control l I try to press here control l and then you can see here there is nothing ok.

Now, if you try to see here I try to highlight library MASS and then I try to press here Run. And then what you have to observe you have to observe here what is going to happen here in the R console here where I am trying to move my cursor. So, now, you see I press this Run. So, you can see here now this is executed on the R console. So, you can see now this will give you a good feeling, that whatever you are doing here this window, window number 1 that is working just like your text editor. That you did in the case of R console also.

And whatever you are trying to execute that is not happening in R Studio, but that is happening in R software also which is now attached inside the R Studio software, right, ok. So, now, we come back to our slide and we try to move slowly towards other things.

(Refer Slide Time: 11:59)



**Data Editor**

There is a data editor within R that can be accessed from the menu bar by selecting Edit/Data editor.

Provide the name of the matrix or data frame that we want to edit and a `Data Editor` window appears.

Alternatively we can do this from the command line using the `fix` function.

Example:
```
library(MASS)
attach(bacteria)
fix(bacteria)
```

So, this I have explained you now and then yeah in case if you want to open here a new file you want to create here editor that you use in the case of R software. Then this can be done here also just go to the file and then you have choose the edit oblique Data Editor and then whatever the name you want to give to the matrix or data frame that you want to edit for that the Data Editor window will appear. Now in case if you want to do it alternatively also, you can use here the fixed function. Well here I would like to clarify that I am using here two names matrix and data frames.

So, up to now we have not discussed what is data frame that we will try to discuss in the forthcoming lectures. This matrix we will try to explain you that how are you going to do it. So, suppose I try to execute these three things here.
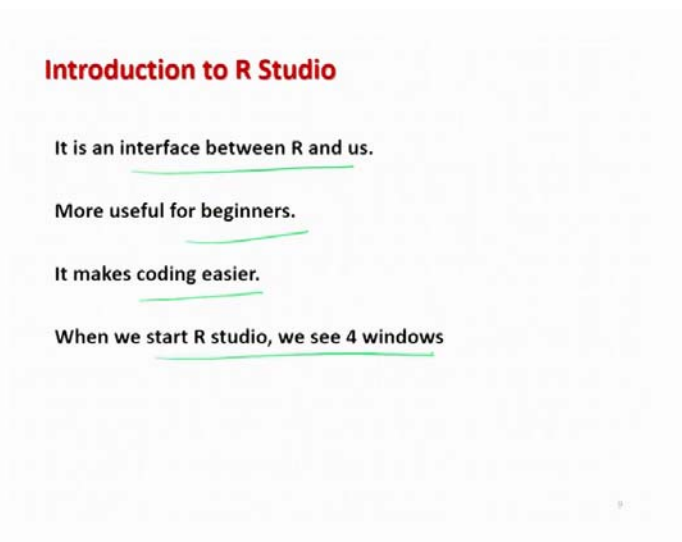
(Refer Slide Time: 13:00)



So, first I would like to show you that what will really happen when you try to do it in the R Studio through the slides and screenshot. So, as soon as you say here this attach bacteria and fix bacteria here this type of Data Editor will open.
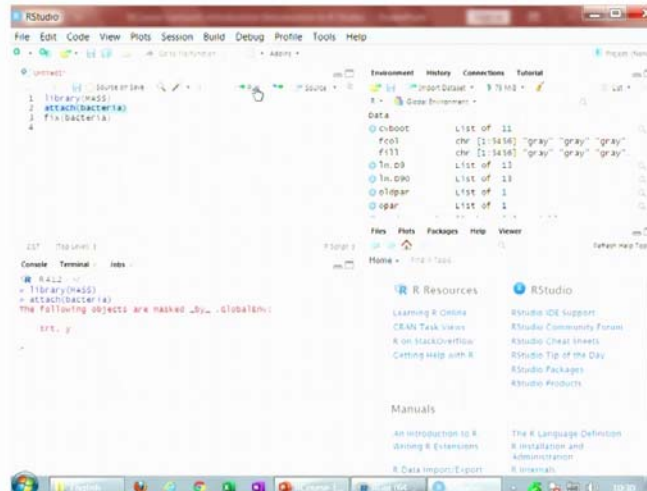
This data is simply this is the data file whose name is bacteria. Yeah, this can be any other data file also without any problem, right. And this data file is actually available inside the MASS package, right. So, and here if you wish you can source it. So, that you can use it conveniently whenever you are trying to do the this programming.
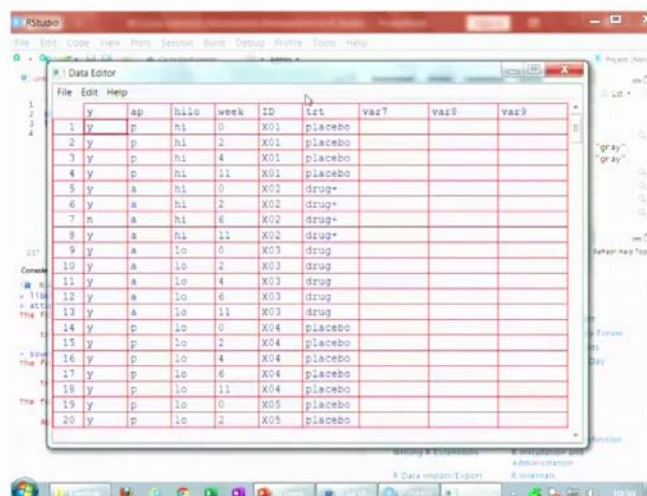
(Refer Slide Time: 13:45)

So, now, if I try to show you here that how it will happen in the R Studio possibly that will make you more confident. So, if you try to see here I am trying to say here attach bacteria.

(Refer Slide Time: 14:00)



 And if I say here Run right.

(Refer Slide Time: 14:04)



So, or if I try to now in case if I try to press on the source you can see here that this has appeared. So, this is simply your here the data file whose name is bacteria. Well it has

got some variables, some data values. So, I am not going to discuss what it is trying to show you here, but anyway my objective was something else. And now in case if you try to write here fix bacteria and if you try to say here run the same thing you can do here also, you can see here the same file is opened, right.

(Refer Slide Time: 14:44)
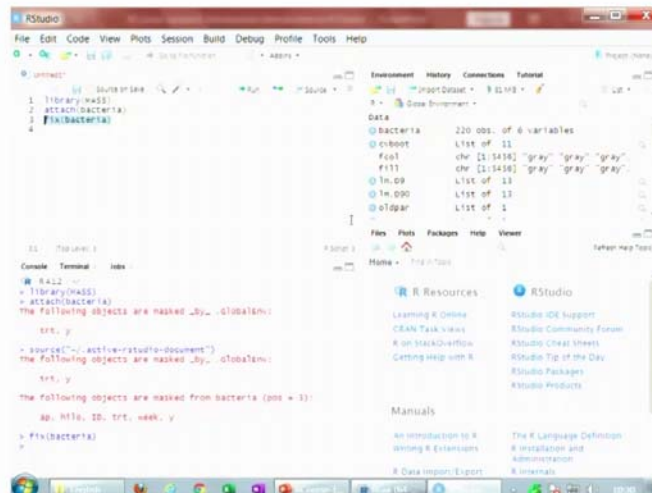


So, this is the objective and what I wanted to fulfil and you can see here as soon as I had done fix bacteria then this file was opened, ok. So, now, you have understood that what is really happening with this R Studio. So, now, you have a fair idea that what I was going to tell you that this R Studio is a sort of interface between R and actually us. And it is more useful now as you have seen for beginners and it makes the coding and programming easier.

(Refer Slide Time: 15:24)
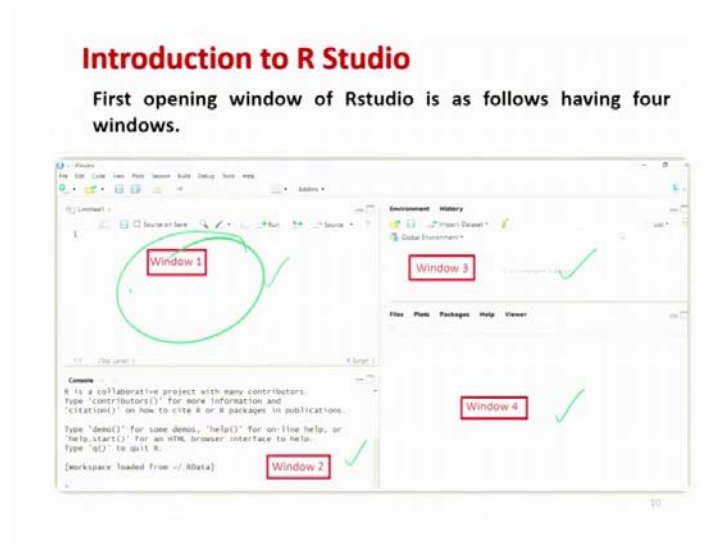


And when we start the R studio we see this these following four windows: windows 1, windows 2, windows 3 and windows 4. Now, you will understand it very easily that what is really going to happen right.

(Refer Slide Time: 15:32)
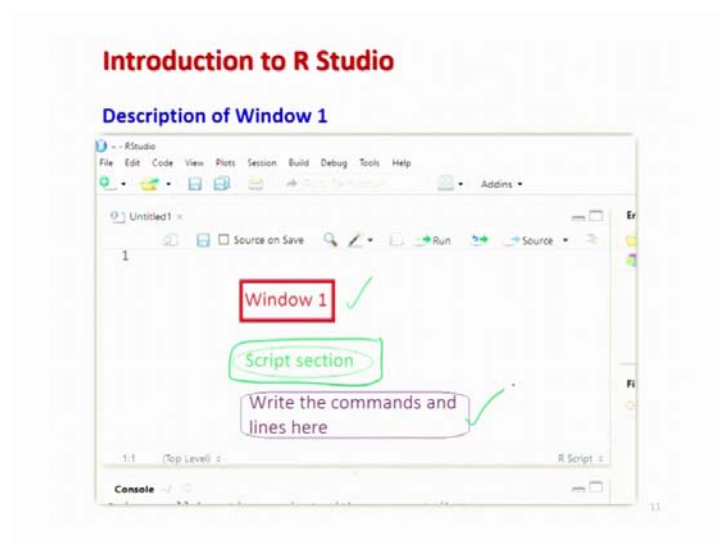


So, now, I can briefly tell you what about this here window number 1 which is here. This window is essentially is used to write the commands and the syntax and this is essentially called as a script where you try to write down the script of your program, right
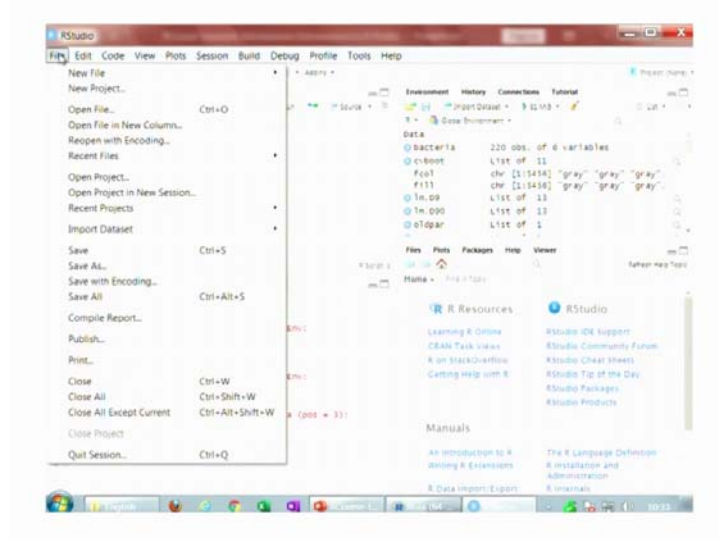
(Refer Slide Time: 15:55)
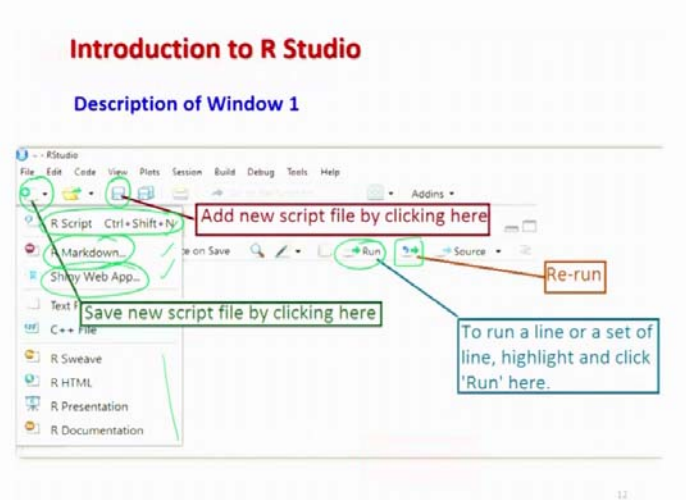


And then yeah in case if you want to open a new file to write down your script. You simply have to go to here this button and then once you try to click here you will see here different types of option R script, R markdown, shiny web etc. etc., right. So, you simply have to click here on the R scrip,t right. And then means a new file will be opened. Now, if you want to save this file you simply have to come to this button here which is indicating the save.

And then if you want to execute the commands which you have type you have to press here Run. And there is here one more button on the right hand side of Run that if you want to rerun the lines you simply have to click here, right. And yeah in order to run you know that you have to highlight the commands and then you have to click on the run. So, I can show you here this thing and then yeah you can she see here there is a option for R markdown, Shiny Web application, R sweave, R html.

So, one thing I can just share with you just for the sake of your information. I am not going into that much detail. That now this R is developed in various directions and many many applications have appeared which are related to this here R, for handling data a file, data management etc. So, all these options which I shown you here like as here this one they will be; they will be coming over here, right.
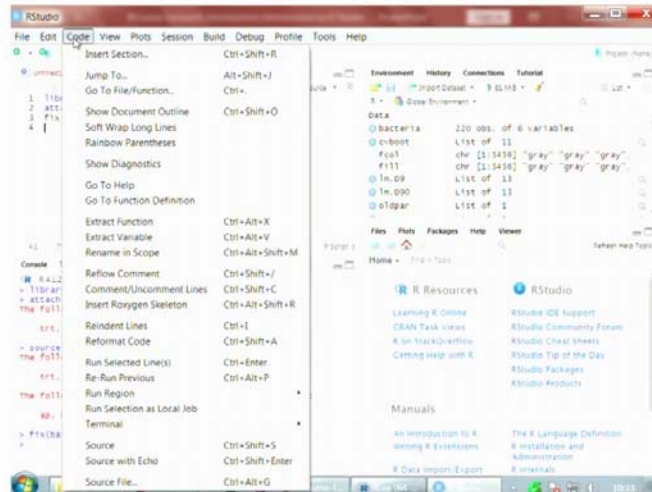
(Refer Slide Time: 17:22)
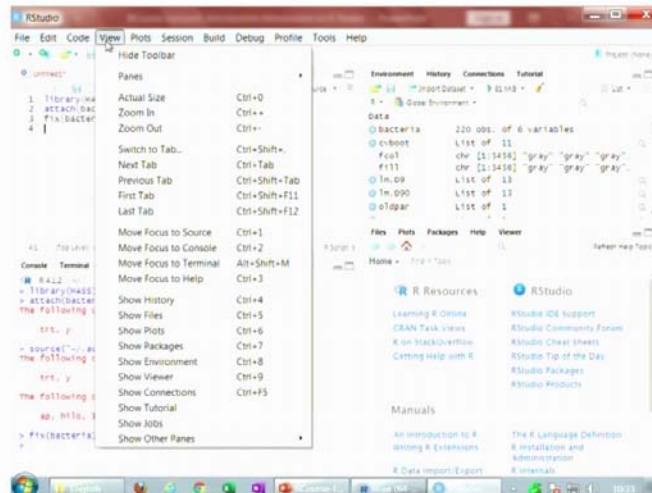


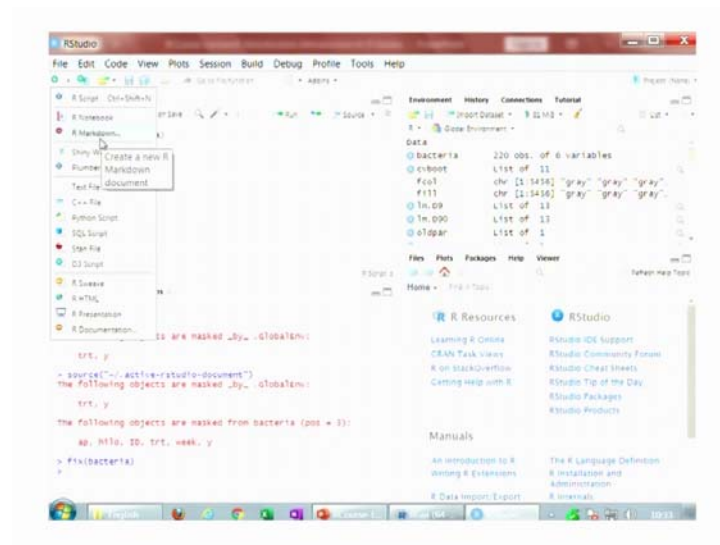(Refer Slide Time: 17:27)
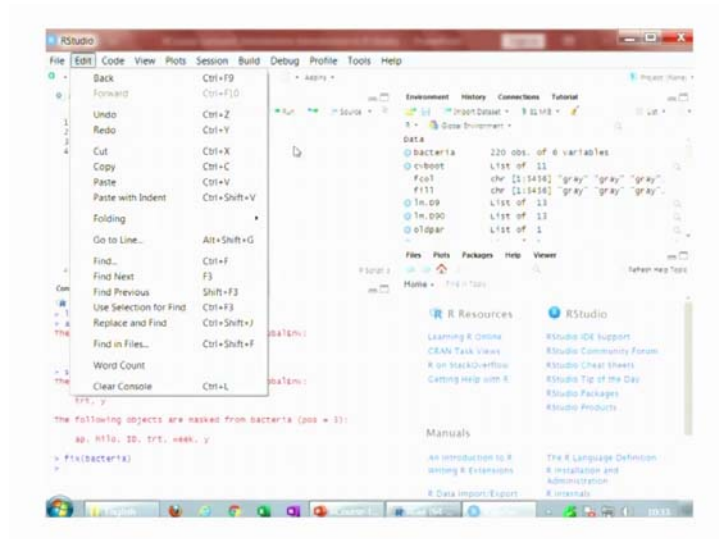


(Refer Slide Time: 17:29)

So, this is file, this is edit, this is code you can see there are many options.
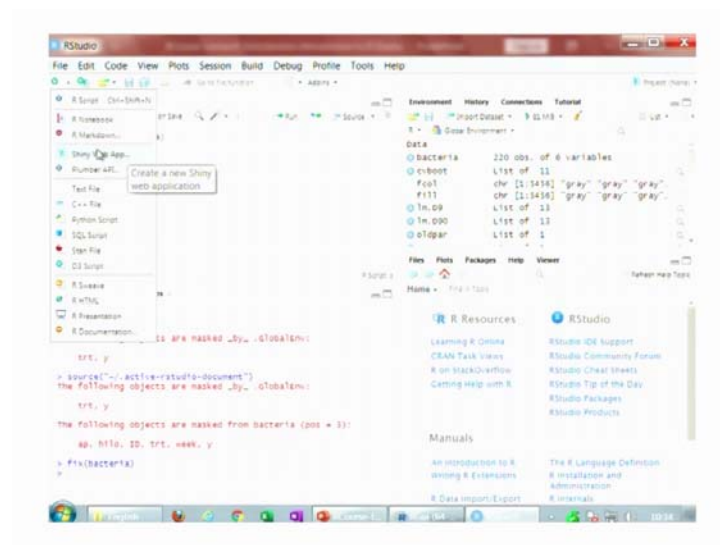
(Refer Slide Time: 17:32)



So, even if you are a professional programmer you will find it very useful when you are trying to work on this.

(Refer Slide Time: 17:41)



But if you try to click over here you can see here now there is an option here R script, R notebook, R mark markdown etc.

(Refer Slide Time: 17:49)



So, once you learn this R software and you have understood it possibly you can learn how to use this R markdown, Shiny, Web etc., right. I am not going to under to explain you these thing.

(Refer Slide Time: 18:06)



And beside this thing R is this R studio also is used for writing the Python Script etc. Python Script, SQL Script etc. So, these are the latest developments in the R Studio and. So, if you try to open here if you try to click here on the R script.

(Refer Slide Time: 18:21).



So, if you try to click here now you can see here a new window has been opened here. Where you can write whatever you want if you want to save here this is here save and then if you want to go to any file or folder you can just type here the address with the backslash sign.

And then this is here about Run then this is here rerun that I told you and this is here source, right. So, I hope this makes the understanding of the window number one quite clear and so, we can come back to our slides and try to understand more, ok.

(Refer Slide Time: 18:57)



 Now, I come to window number 2. Window number 2 you know it was very easy. This is simply your here R console, right. All these the window all this syntax which you write inside the R program window they appear here and now you know that after spending so much of time with this R software. That all type of calculation etc. they take with inside the console window only. So, one can write the programs here, but as we have now understood that it is not so convenient to write multi line program in the R console. So, that is why we try to take the help of R text editor. So, but anyway that is not a big deal.

So, this you already have seen or I can show you here just for the sake of completeness that in this R studio. You can see here this is your window number 2 which is your here R console. So, I can make it clear here control L. So, that you can see here very clearly, ok.

(Refer Slide Time: 20:04)
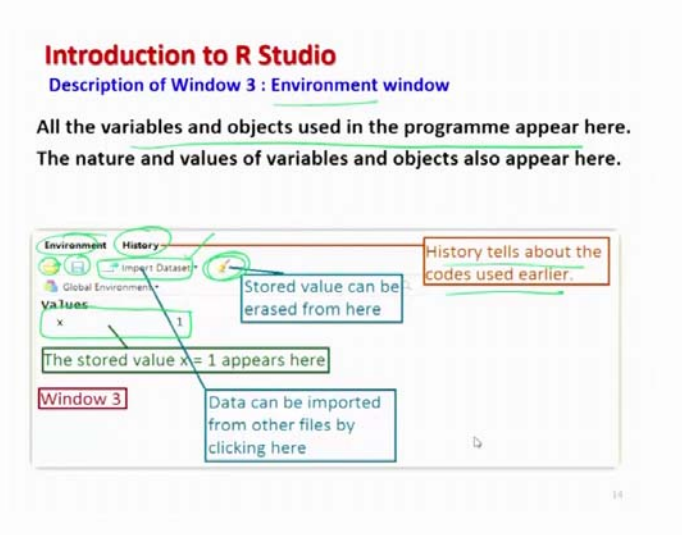


So, now, after this you come to window number here 3. So, window number 3 first let me try to explain you here actually this is a window where you get to know about the environment of your variable and what are the variables that you have used. What are the values they have been chosen? What are the type of data which has been stored in those values? All such important information is there. So, all the variables and objects whatever you have used in this program, they appear here. And it is not like that if you are working today and if you shut down your computer, but if you restart your computer or restart your program, even then those variables those values will be stored here and you can use them here.

The same thing is possible in the R software also when we are trying to work in the R console and, but the thing is this you have to look into those values by using certain command that we will discuss in the forthcoming lectures; that means, you have to check the content of the directory that what type of variables are there, but in this case, but in the case of R studio all these things are available directly, right. So, you can see it see them in a single glance, right.

So, now if you try to understand here suppose if I try to if I have defined a variable here x equal to 1. So, you can see here this is appearing here x equal to 1. And similarly here there are two option environment and history. So, history will give you that what are the codes, what are the programs, what are the values, what are the variable that you have

used earlier. And then you have here next option here file and then here save and after this there is an option here Import Dataset.

Import Dataset means, well we have not done up to now, but again I will say that ok we will discuss in the forthcoming lecture. That in R when you want to read the data from different resources like as MS excel or some TXT or CSV format then we have certain commands in the R software which have to be executed. So, that those data sets can be brought into the R software. So, here in this R Studio this gives you a direct access that just by clicking on this command you can call those data files inside the R software.

So, this is about the import data sets. And then in case if you want to erase the stored values here, there is a button here which is like a broom. So, you can just click here and then the stored values can be erased, but I will request you that you please try to take some values and try to execute these operations. So, that you are more comfortable with these things and before I go further I would like to show you it here also you can see here you have just opened the site here bacteria.

So, you can see here bacteria it is telling you have to just look at my cursor where I am moving my cursor that is this 220 observations of 6 variables and so on. And earlier I have used these programs like a cvboot this is the list of 11 values etc. etc., right. So, you can see here that all this information which have been used on this computer, this is available here, ok. Now, this is about environment.

(Refer Slide Time: 23:46)
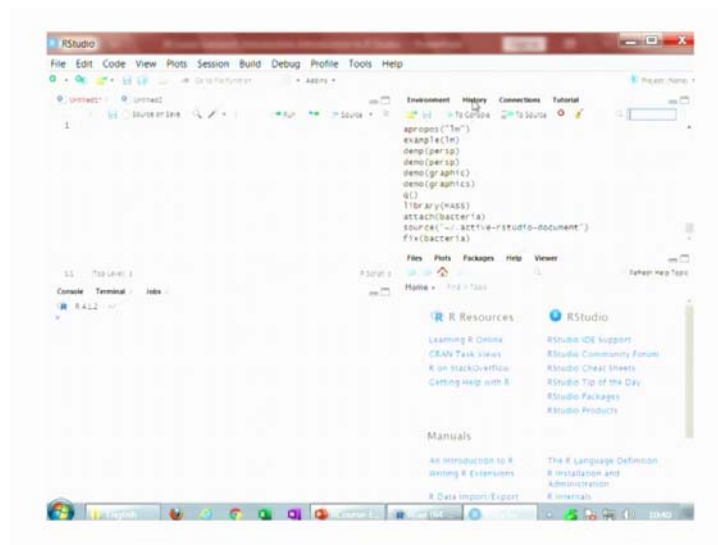


Now, in case if you come to here history you can see here that in the past what type of commands which have been have been used here.
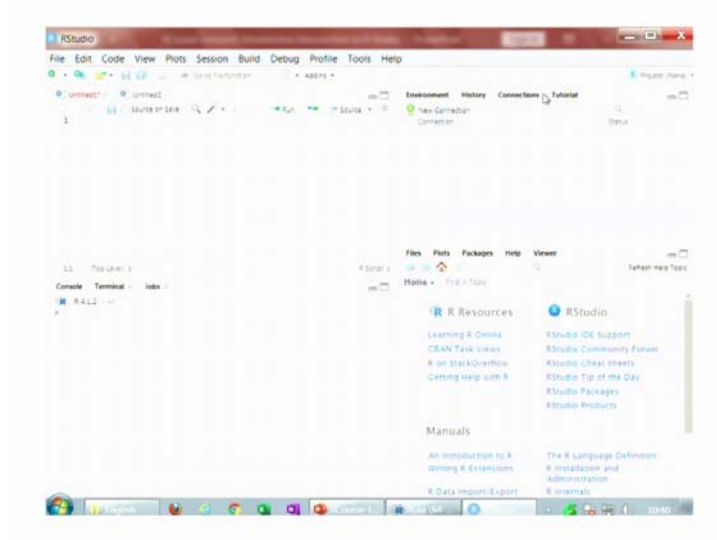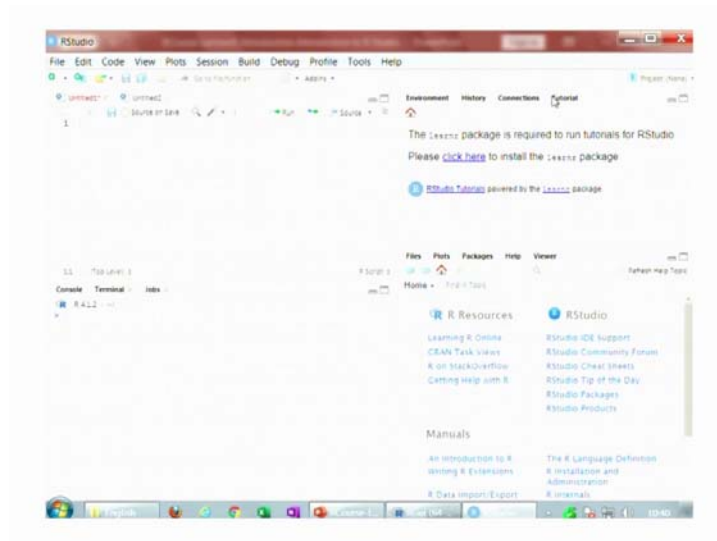
(Refer Slide Time: 23:54)
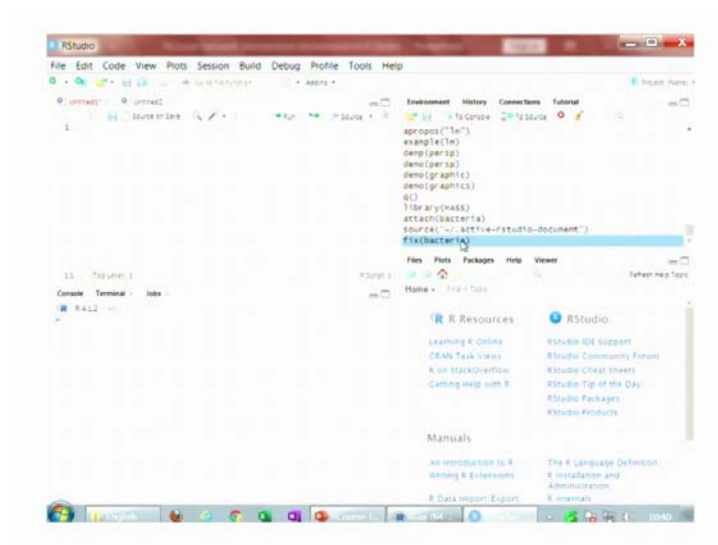


For example, if you can see here you have just used the command fix bacteria. So, it is available here before that you have used the command library MASS and attach bacteria they are also here and after that you have sourced these files.

So, you can see here this is giving you a complete idea that what you have done in the past. So, this is about history.
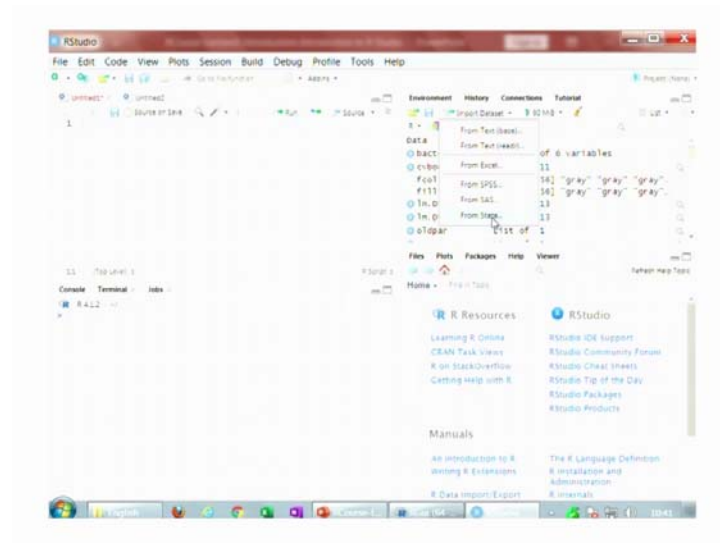
(Refer Slide Time: 24:17)



(Refer Slide Time: 24:19)



And then we have here connection tutorials you can see here if you want to know about this R studio better.

(Refer Slide Time: 24:26)



And similarly if you try to see here import data set you can see here from Text that is the t x t files then read our file from Excel from SPSS from SAS from Stata  they are different statistical software.

So, you can call those data file inside the this software and then you can work right. So, now, after this can we come to our 4th window.

(Refer Slide Time: 24:56)
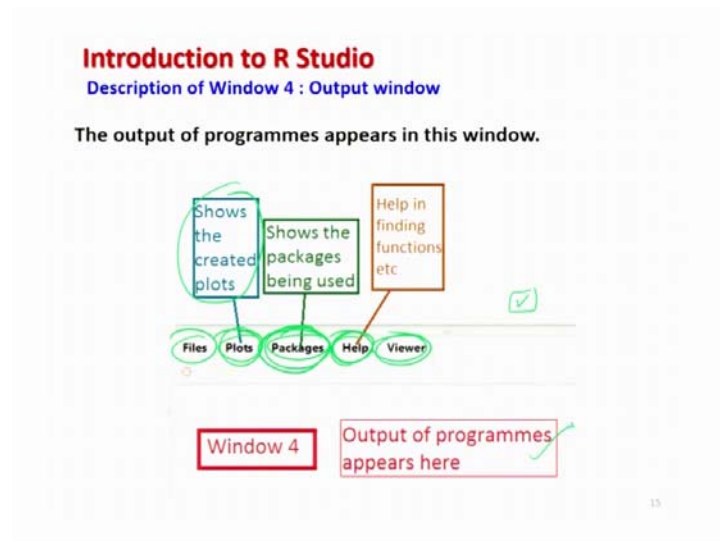
Where I can show you that what are you going to do yeah 4th window has several functions. So, if you try to see here that is actually an output window that whatever is the output of your these execution that will appear here.

So, you can see here Files, then Plots, then Packages, then Help and then Viewer. So, the files is files means who can see what sort of files are there. Then plots plot will show you that what type of plots you are trying to create they will appear here and then there is an option here packages. So, this list will show you that what are the packages which are available on your computer and if you want to use them you will see that it is very convenient to use them you simply have to make a check box inside a box.

You have to simply make this mark inside a box and the package will be loaded. Instead of you use the function install dot packages. And then there is here help and then here viewer if you want to view those graphics and other things, right. So, basically the output of these programs that appear here, right.

(Refer Slide Time: 26:08)



So, now, for example, if you want to look into this package means I can show you and then I will try to show you on the R Studio also. That when you are trying to use package. Suppose you click here. And then you will see here a list of the packages which are available on your computer. Remember this list might be different than what you are trying to look on your own computer, because these are the packages which are available

on my laptop on my computer. So, now, if you try to see here I have here couple of package whose name is Agreement, bayesm, composition etc.

Now, in case if I want to use any package; that means, I want to use the command library. I simply have to make inside this box, I have to make here a tick mark. And then it will load the package and similarly if I want to load another package bayesm I can make here tick mark and it will be loaded. Now if you try to look here there is another command here install. So, do you remember that when we wanted to install a package we used to use a command install dot packages and then it will go to a site and then from where it is downloaded and installed.

So, now in this case if you simply click over install then from here you can type the name of the package which you want to install and it will be automatically installed.

(Refer Slide Time: 27:52)
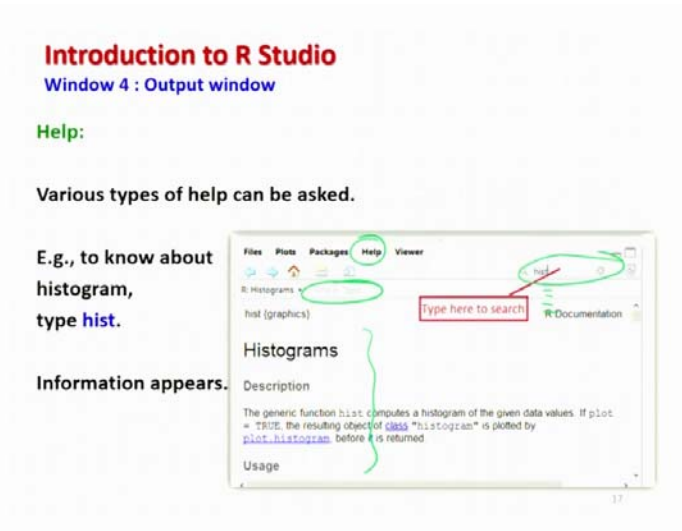


Similarly we had learnt about the command to update the package for that you simply have to click here update and then those packages will be updated. Similarly after that in case if you want to come on the help part here after this. So, if you simply go to here this window. Suppose I want to know about the information about Histogram.

So, as soon as you type here h i s t some more information will be coming here and then you can click here on the hist and it will show you here the all details about the Histograms that how you can create here. So, various types of helps that is available here

and then within Histogram also you can type here something and then it will show it show here. So, you can recall that in the beginning of the course we have discussed couple of ways to take the help in the R software.

But now in the R studio most of those things have been combined at one place, right.

(Refer Slide Time: 28:43)
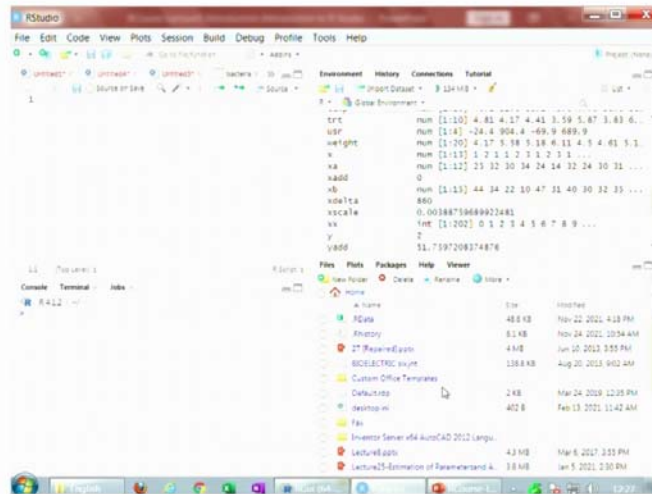


So, let me try to show you these things on the R console itself and then I will try to show you an example also. So, suppose if I want to look at here files. So, these are the files which are available in my home directory.

(Refer Slide Time: 28:57)
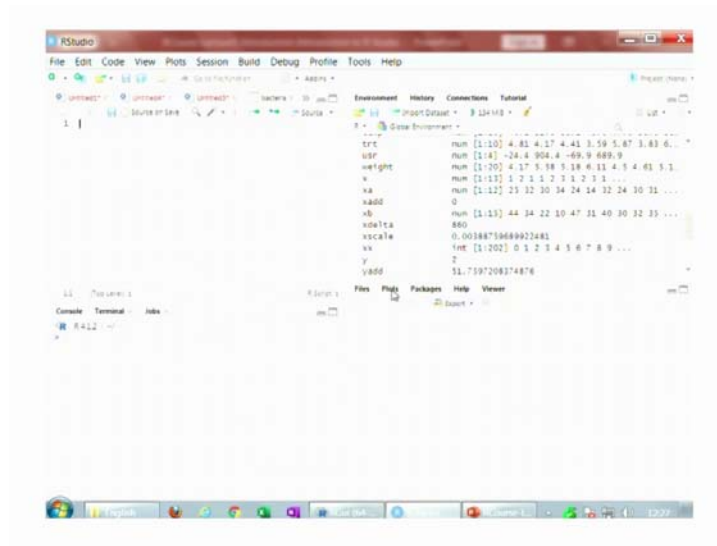


And then we have here plots.

(Refer Slide Time: 29:00)
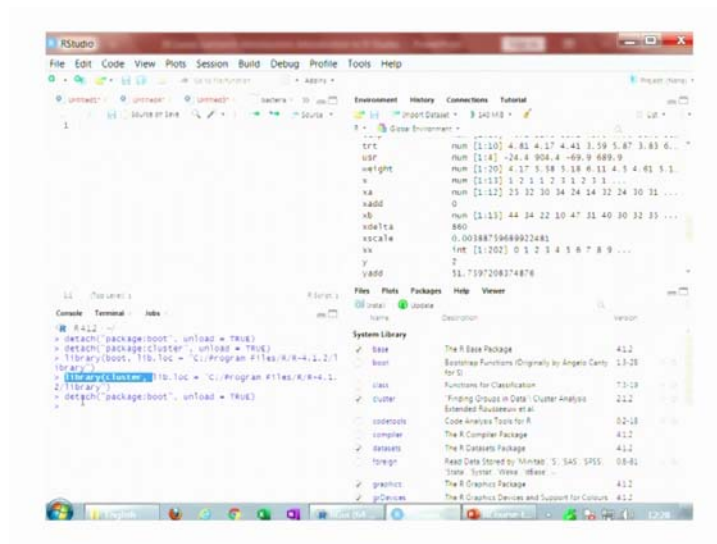


Then we have here packages. So, packages you can see here and that in this computer there are various types of packages which are available.

For example, there is a here boot package, then here cluster package. So, you can see here means if I want to load this package, you simply have to make a click and then this check box and you can see here that this library boot has been executed. And if I want to

load the package cluster then if I click here then the library cluster is uploaded. So, the only difference is that whatever command you were using in the R console, they are the same command which are executed here, but you do not have to do it yourself.
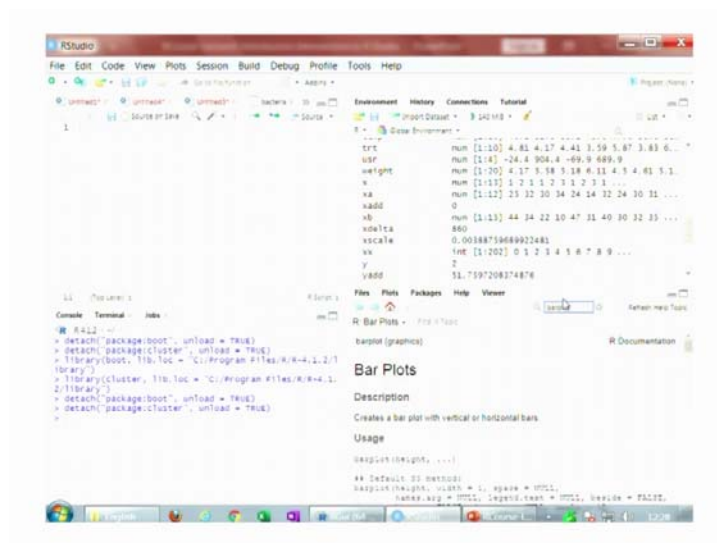
But they can be done only by a click. And if you want to remove this one for example, if you want to remove here boot, you just click here and you can see here the detach command has been used and similarly for the cluster this has been unloaded from the this R studio.

(Refer Slide Time: 30:00)



And after this you have here help. So, if you for example, if you want to have here some information about the Histogram.
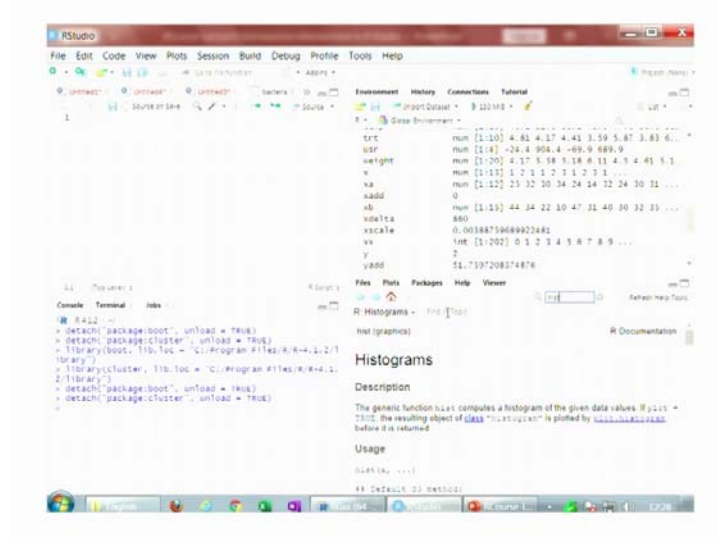
Suppose if I try to type here h i s t you can see here that these things are coming in the drop down and you can click here. And then you can see here the information about this Histogram is available and within this topic if you want to find out something. It will also come here, right. So, now, let me try to clear this screen.

**Introduction to R Studio**

Example:

Bar diagram of values 1,2,1,1,2,3,1,2,3,1,2,2,3

R studio has following operation and output:
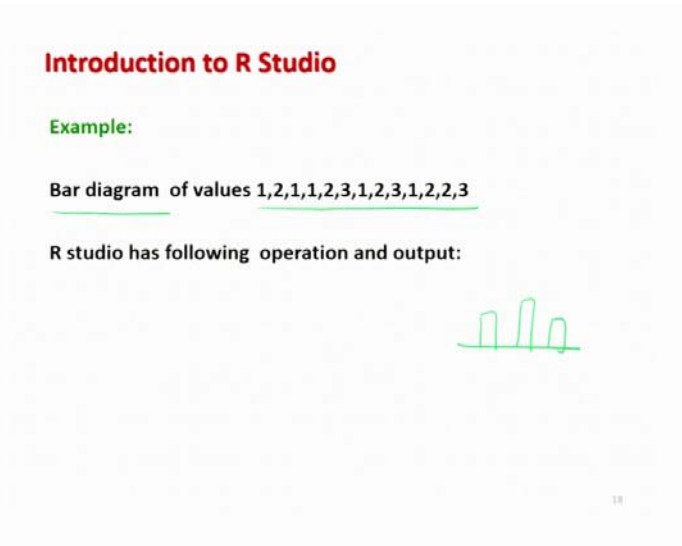
And let me try to take here an example to show you that how these four windows work together when we are trying to do something over here. So, in case if you try to see here I

want to create here a bar diagram. Bar diagram you know that is a very simple thing. It is something like a bars are created here.

And I want to create this bar diagram for these values: 1,2,1,1,2,3,1,2,3,1,2,2,3. Now, how to create this bar diagram how to input the data these are the things which we are going to discuss in more detail in forthcoming lecture, but at this moment my simple objective is to 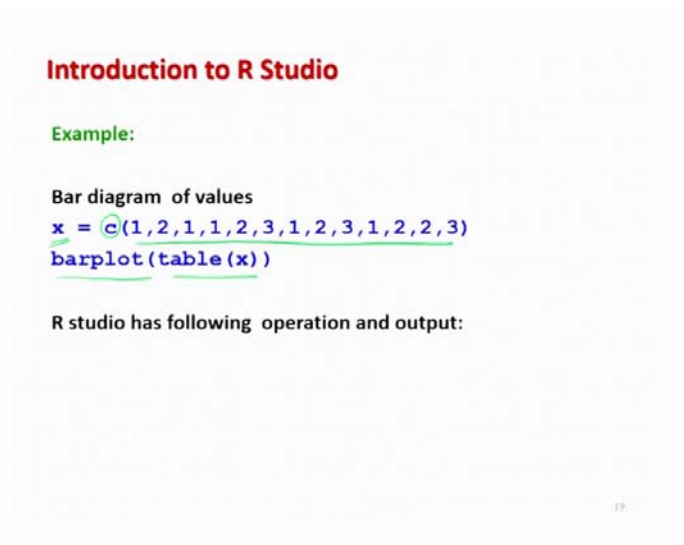show you that when we are working in R studio then how simultaneously all the 4 windows are working together to get an outcome, right.

(Refer Slide Time: 31:18)



**Introduction to R Studio**

Example:

Bar diagram of values
x = c(1,2,1,1,2,3,1,2,3,1,2,2,3)
barplot(table(x))

R studio has following operation and output:

So, now just for your information at this moment I can share with you. That if you want to input the data you have to write the data inside the parenthesis and then you have to write here a command c and you have to store it inside a variable x and after that you have to just write the command bar plot table and within parenthesis x. And this will give you a bar plot. So, let me try to execute this command on the R console which is inside the R software and try to show you that how the things are happening. So, let me try to copy this data value. So, that there is no error.

(Refer Slide Time: 31:57)
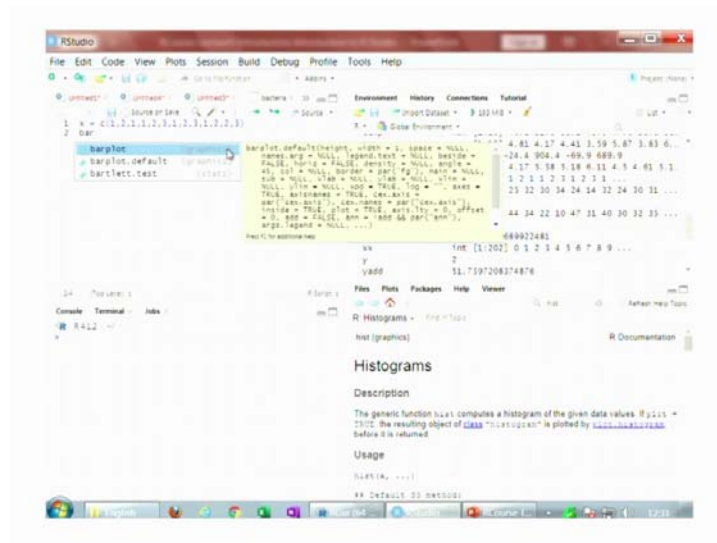


So, if I try to see it here this is my data value and then I try to type here bar plot. You see as soon as I type here bar plot. Something is coming in the drop down and if you try to highlight over this or move your cursor over this you will get here many information. So, the this is how this R software is helpful, when we are trying to use it through the R Studio software, right.

So, this R Studio software help us. So, now, you can see here you can have a fair idea

(Refer Slide Time: 32:30)

And if you click here this bar plot will come and after that I have to type table. So, as soon as I start typing you can see here that this table comes in the drop down and I can choose from here. So, this will avoid the mistakes and even the parenthesis is coming automatically. And after this I have to write down here bar plot table x. Now, I try to highlight it and after that I am going to press on the run command.

But what you have to observe is that what is happening in all the four windows. So, now, I click here on the run.

(Refer Slide Time: 33:05)



And you can see here what is happened. In the window number 2 here, these two commands are executed. And now you can see here in this window number 3 this x is giving you all these values over here, which are here. So, you can see here that these values are here and even if you try to go to the history here possibly you can find out what you have done today, right.

So, you can see here this is the command which you have used here bar plot table x. Now, if you come to the 4th window here, here you can see this is your bar plot.

(Refer Slide Time: 33:26)



And if you try to press it on the zoom.

(Refer Slide Time: 33:46)



This will give you a bigger image which is more clear and in case if you want to save it you just come to the export it will give you different options like a save as image, save as PDF etc. etc.
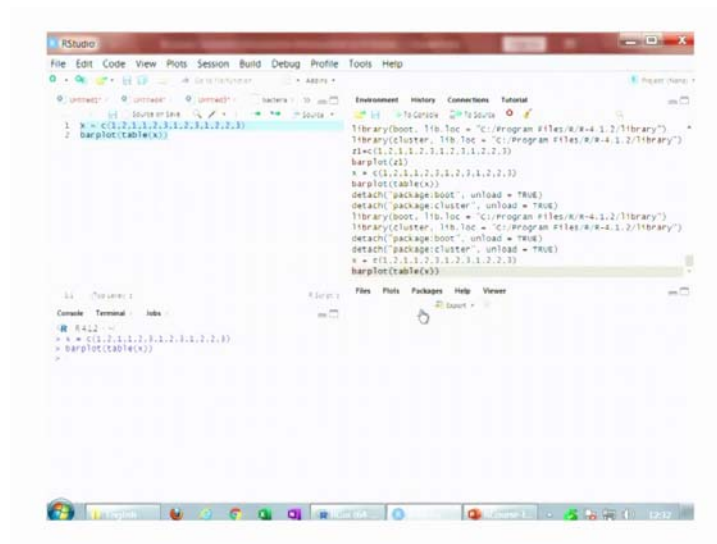
And after that in case if you want to remove this graphic you simply have to click here, and then as soon as I say here click on this red cross button.

(Refer Slide Time: 34:11)
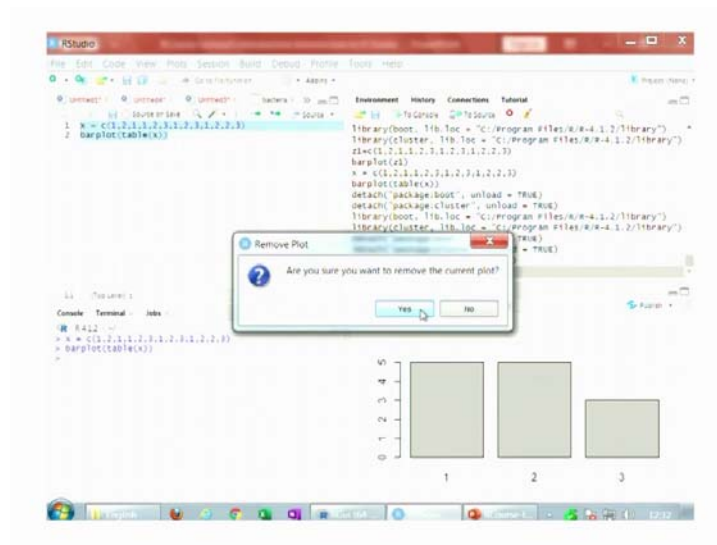


 It will ask me are you sure you want to remove the current plot I will say yes.

(Refer Slide Time: 34:14)



And you can see here this plot is removed from here. So, now, you can see that it is quite helpful when we are trying to work in the R software through R Studio. Well as I said that R Studio is not the only software there are some other software also and it is your wish what you want to choose.

But my idea was very simple. I wanted to demonstrate, that when you are trying to take the help of an external software like R studio. Then how you have to think how you have to manage and how the things are going to be different. Than what you are doing in the R console, but above all you can see now here whatever you are trying to do, R studio is not doing anything this is only a friend. Whatever is happening that is happening only inside the R console.

And second thing is when you are trying to work in the R Studio, you are simply for example, in order to install a package or to load a package you are simply making a click, but think of a situation that you are trying to write a program, big program then at that moment you would need the command like install dot packages or library command so that you can write it inside the program.

So, that the user does not have to install that package externally or the user has to load the library first etc. because your user does not know what you have done. So, that is why these commands are also needed. So, that is the advantage of working with this R studio, but once again I would say R studio has many more capabilities.

But I have taken only here some capabilities just to demonstrate that how it can help you, but I would now request you that you try to play with this R Studio software try to see what are the different option, different function, different capabilities which are available and try to explore them.

The more you explore the more you will learn. And the good thing will be that whatever you have done up to now in the R console, try to see how the same thing can be done in the R studio software. And this will an open exercise that when you are trying to learn more commands in the further lectures, try to see how the same thing can be done in the R Studio software also. So, I would recommend you that we will work together only in the R console.

So, that we can work with the basic fundamentals and after you have learnt it that will be your choice, whether you want to work in the R console or in the R Studio. So, you try to practice this try to take some issues and try to solve them inside the R Studio software and I will see you in the next lecture, till then goodbye.