Essentials of Data Science with R Software – 1
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Lecture No. 04
Calculations with R as a Calculator

Hello friends, welcome to the course Essentials of Data Science with R Software 1, in which we are trying to understand the basic topics of probability theory and statistical inference. But, in this lecture, we are going to understand the basic operation of the R software. As I discussed in the last 2 lectures that I would like to give you some basic ideas or the basic operations of the R software, which are going to help you in learning of the further lectures. So, with that objective in the last lecture, I have given you a brief introduction to the R studio, and in this lecture, I will try to give you a quick review of the basic mathematical operations in R.

You know, that in R you can use this R just like a calculator means what means how to do addition, subtraction, multiplication division type of basic operation, how are you going to do it, and how they are going to help you? That is my very modest objective in this lecture. Although, I know that most of you know about it, but it is not a bad option to have a quick review of those things. So, let us begin our lecture and I will try to show you here on the slides and I will be showing you the same operation on the R console also so that you feel more confident about it. So, let us begin our lecture.

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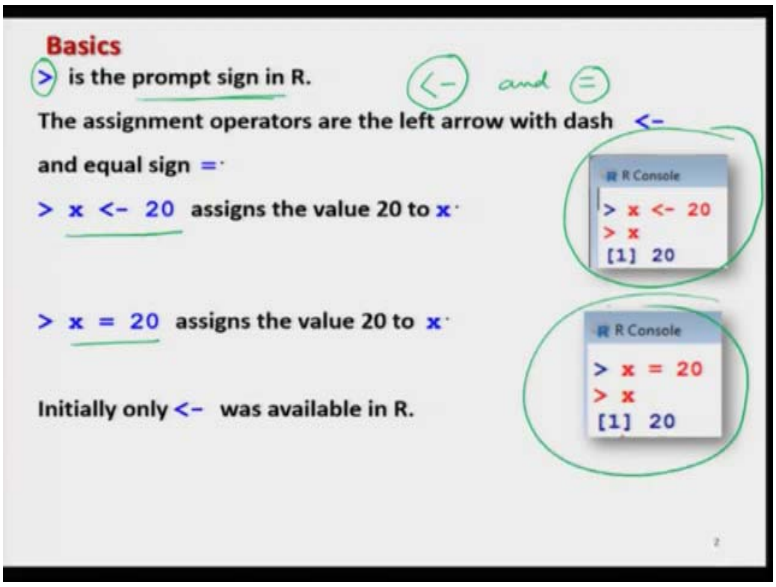

So, and in this lecture, we are simply going to learn about the basic calculations and using this R software as a calculator. So, now, we know that this symbol this greater than symbol on the R console or at the command line is the prompt sign, that we know. And the assignment operator in the R software is equality sign or less than dash. So, essentially there are two assignment operators, one is like this less than and hyphen and the second is the same as equality sign. So, actually means that you know that when this R started at that time, people were trying to develop it on the same lines as the software S plus. And in S plus software, the assignment operator was like this one, less than the hyphen sign.

So, when R started, people started at the same assignment operator in R software also. And later on they change it equality sign, which was a more popular assignment operator among all the programmers and software. So, now, as of today, both these operators are available in the R software and whether you try to write down here x less than hyphen 20 or if you try to write down here x equal to 20, both are going to do the same thing that they are going to assign the value 20 to x.

But here I would like to tell you one thing that inside the slides, sometimes you will see the sign less than a hyphen, and sometimes you will see the sign equality. The reason for this is that well I am now much older than you and to most of you. And when I was a student at that time the computers started coming to India and I am the one who has witnessed the growth and development of computers in India and different types of software. So, all these S plus, R, Windows, MS Word, Excel etc., all these software's they came after I completed my Ph.D. or whenever just going to complete my Ph.D. and this is almost now 25 years since I completed my Ph.D. So, I have seen the change and growth of these software and statistical software.

So, when I started learning this S plus software, then I was using the same assignment operator less than hyphen. And when this R came then I started letting the R software also. So once again, I have a because the only available operator was less than hyphens. So, I was using the same thing. And a couple of years back this R version got updated and they in cooperated both the assignment operator, less than hyphen sign, and equality sign. So, now, I have used and practice with this less than hyphen sign for a large number of years, for many years I have used this symbol.

So, now I have changed myself to using this equality sign, but sometimes because of habit, old habits die hard, so this operator also comes. Well, I hope you will not mind even if I am

writing the less than hyphen sign or equality sign, but surely, I promise you I will try to improve myself. So, let us come back to our slides. So, now, in case if you try to do the same thing in the R console also you will get here this type of outcome and these are the screenshots, so, I will try to show you it on the R console also.

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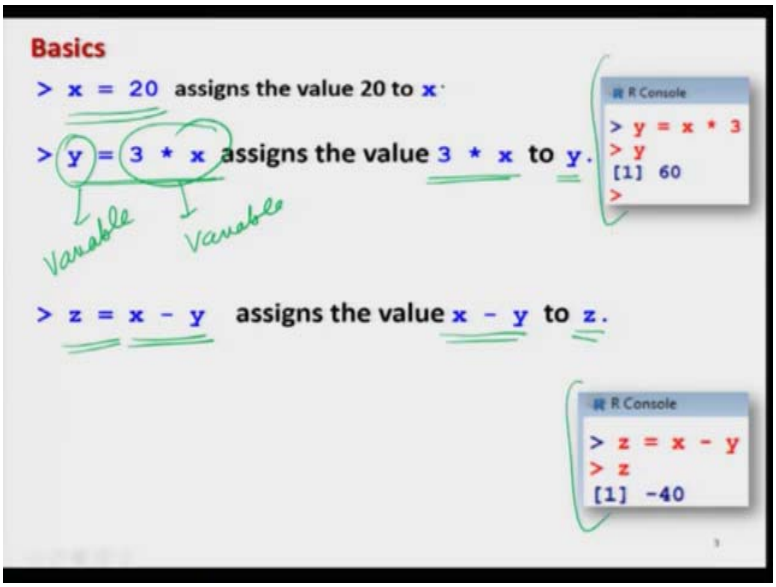

But before that, in this R software, it is possible to assign the numerical, the numbers to a variable, as well as our variable can be assigned to another variable. For example, if I say x equal to 20, so, this command is going to assign the value 20 to x, and if I write down here another variable y is equal to 3, star x, so, that is three multiplied by x. So, this is going to assign the value 3 into x to new variable y. So, you can see here this part 3 into x that is also a variable, because it depends on the value of x, in case if x equal to 20 is changed to x equal to 30, then y will change from 60 to 90.

So, this part is variable and then y is also here variable. So, now I am trying to assign a variable to another variable. And similarly, if I try to define here a new variable x minus y, then this z is equal to x minus y is going to assign the value x minus y to z. So, once again, both are variable and these are here the screenshots. So, before I try to move to that next slide, please let me try to show you these things on the R console here.

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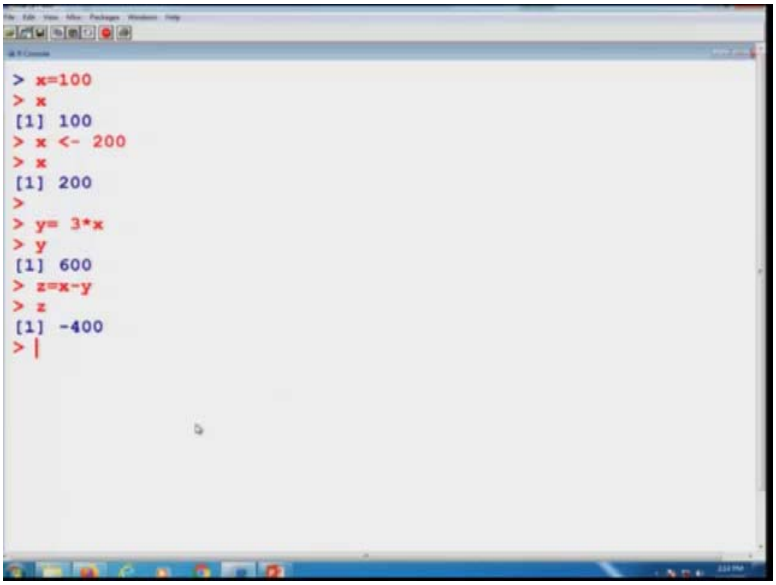

So, you can see here if I try to see here x type x equals to 100. So, you can see here this is here x equals to 100. And, in case if I try to use here enter command here x less than hyphen or if I try to assign here 200, x equal to 200, then now you can see here the value of x has become 200. So, both these operators are working and similarly, if I try to define here one more variable here y is equal to 3 into here x then this is going to be here 3 into x, which is 3 into 200, and the value of y if you want to use, you simply have to press your y and press Enter. This will give you the value 600 because 3 into 200 is 600.

And similarly, if you want to define here a new variable, that is equal to x minus y, you can see here this will come out to be 200 minus 600, which is minus 400. So, this is how the things are going to work.

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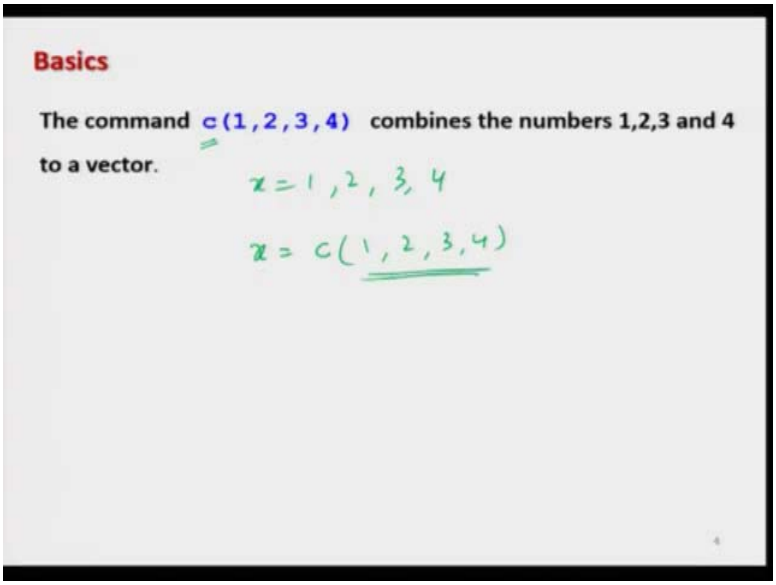

So, now, one thing that you have to understand here that up to now, I have assigned only one value to a variable, but if there are more values that you assign to a variable, then you always have to use the command here c, c means combined. So, in case if you just write here x, 1,2,3,4, may not work. But in case if you write down here X and 1,2,3,4, command c, c 1,2,3,4. Inside the parentheses, you have to write all the numbers separated by the comma, then the R command will understand that the values inside the variable x there are 4 values 1,2,3, and 4.

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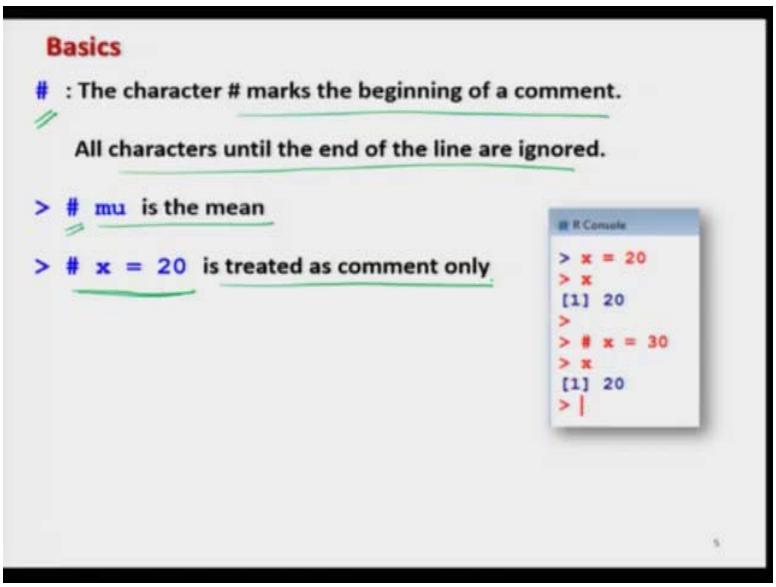

And similarly, in case if you want to write up syntax or a command inside your programming language, which you want that R should not execute it or in simple words, you want to

commenter a command, then the character here is, the command here is hash sign. Means if you write this hash sign before the beginning of a command, then all the commands in that line they will be commented and whatever is written after this hash sign, that will be ignored by the R software. For example, if I want to write down here, mu is the mean. So, I will write down here hash mu is the mean and it will not be executed it will remain as such.

And similarly, if I try to write on here hash x equal to 20, then this will not be executed, but it will be treated only as a comment. So, before I go further, let me try to show you now if you try to come back to your R console.

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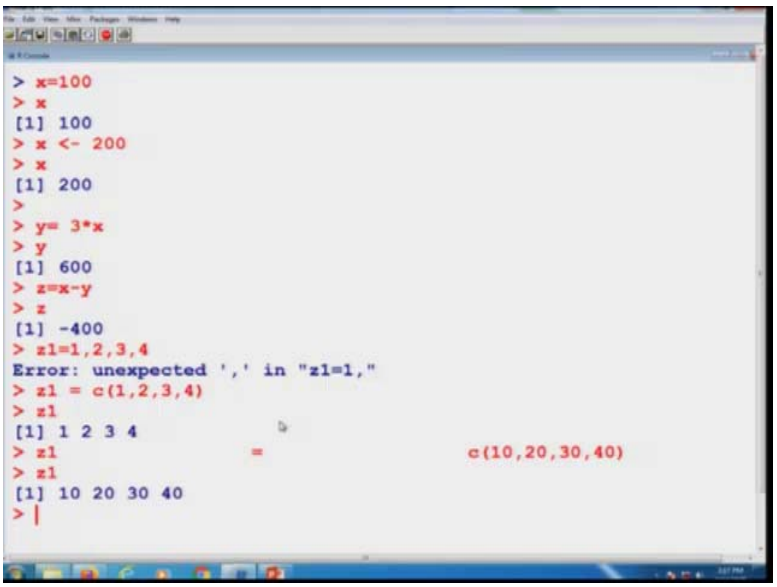

And suppose if I want to write down here, say here some new variable here say z 1 is equal to say here 1,2,3,4. You can see here because this is going to give you an error, but in case if you try to write down here z1 is equal to c 1,2,3,4. Now, it will be here like this, there is no error and you can see the value of z1 as say 1,2,3,4. One thing what you have to remember here that once you are writing such mathematical commands, then there is no value of this blank space even I can write down here like this, and you can see here that I try to write down here that is equal to 10, 20, 30, and 40, and if I try to execute it, there is no problem and is still the value of z1 is now changed to 10, 20, 30, 40.

So, this blank space does not make as long as you are trying to do the mathematical operations, when you are trying to do some comment or some you want to print something then this will make a difference. So, we are talking only off here mathematical operations.

Now, suppose I want to clear this screen, I have to just press Ctrl L. So, I press Ctrl and I now, click on the L.

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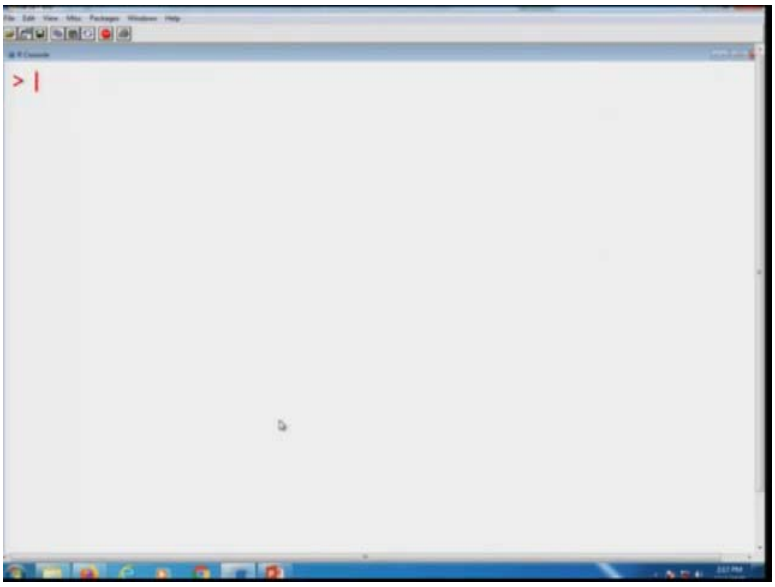

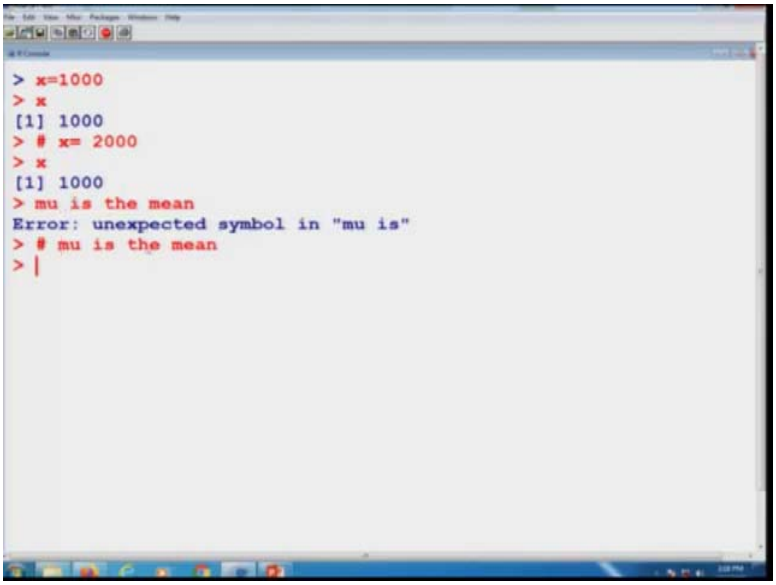

So, it will clear my screen. Now, in case if you try to see here, if I try to give here x equal to say 1000, it will be value here 1000. But in case if I try to write down your hash and x equal to suppose 2000 you can see here nothing is happening, but the value of x will remain as 1000. Because this hash symbol has informed the R that you do not have to execute whatever is written after this. So, that has worked.

So, similarly, if I want to write down here mu is the mean and if you try to just type it here, it will give you that there is an error, but in case if you try to write down your hash, and then

mu is the mean, there is no issue. So, I hope these things are clear, although I know that you are familiar with these things, but I thought that I must inform you.

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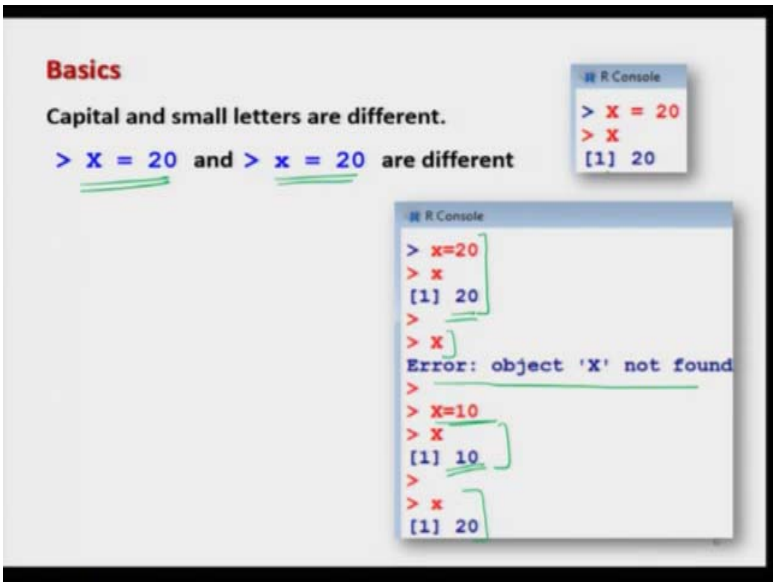

Now, this R is case sensitive, there is a difference between a small letter alphabets and a capital letter alphabets or say lowercase and uppercase alphabets in English. For example, if I try to write down here capital X equal to 20 and a small x equal to 20, then these two are different things. For example, if you try to see here on this screenshot, I am trying to give here, a small x equal to 20 and it is giving me the value of here 20 but there is no capital X.

So, as soon as I try to see the value of capital X it is trying to give us that object X is not found, but if I try to give here capital X equal to 20, and then if I try to see here capital X, then it will give me here the value 10 and this small x will give me the value here 20. So, this should not create any problem for you, but let me try to show you this on the R console also.

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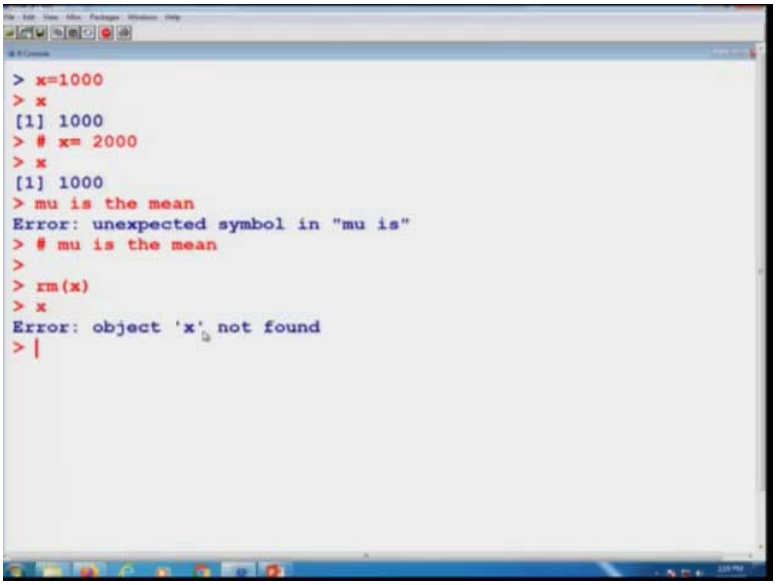

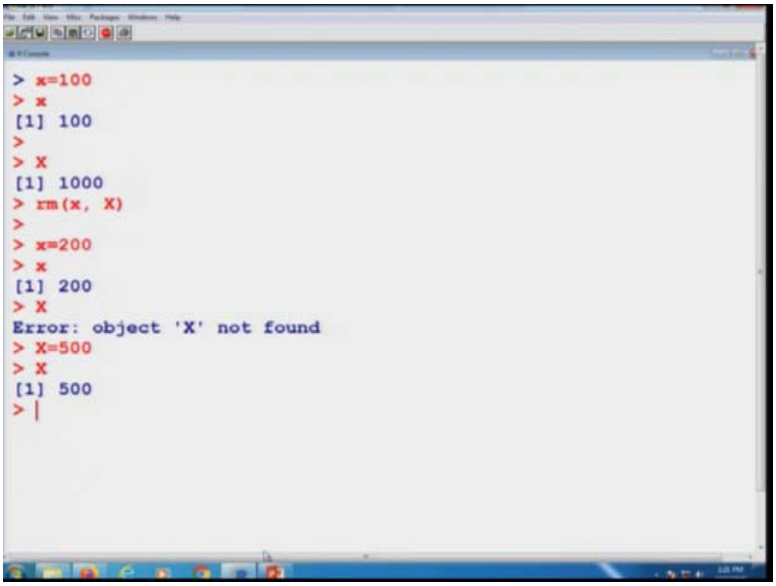

So, suppose if I see here, so, now. Firstly, let me try to remove my here x. So, there is no issue, that there is no x now you can see here there is no x here and I tried to clear my screen by pressing Ctrl L. And now I am trying to say here capital say X and small x, I want to use. So, suppose I say here is small x is equal to suppose here 100.

Now, you can see here it says here a small x. Now, I try to type here capital X and try to see here this value, you can see here this capital X is coming out to be 1000. Do you know why? From where this capital X is coming out because this earlier I had possibly used this variable capital X and that was already available in the R software. So that is what I told you in the earlier lecture also that whenever you are trying to start a new program, the first job is to remove all the variable names which you want to use.

So, first, I should do here, say remove rm small x as well as capital X. Now I can do whatever I want. So, if I try to say here x equal to suppose here. Now, I take here 200. So, you can see here, this is my small x. But in case if I try to find out here the value of capital X, you can see here, this is not found. But in case if I try to say here, capital X equal to 500, you can see here now the value of capital X is coming out to be 500. So, once again, we come back to our slides, and now look at me, I will try to show you some basic operations.

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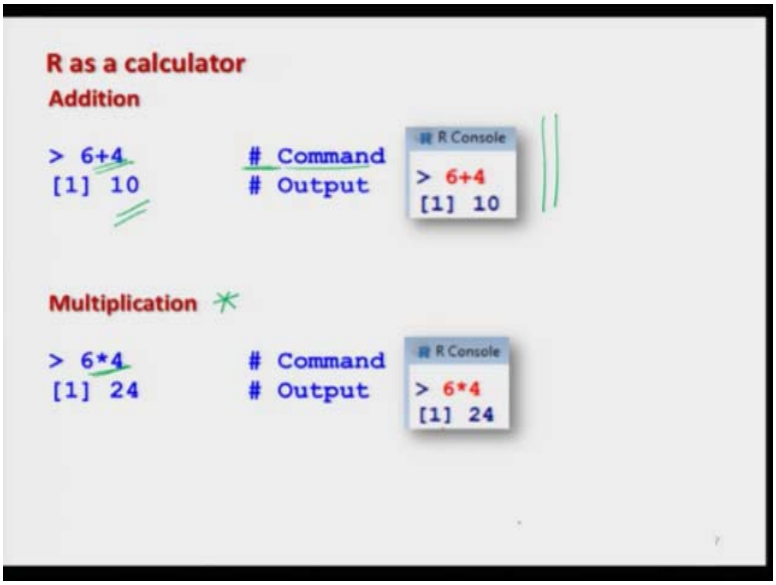

So, in case if you want to do addition of two numbers in the R console, then the usual sign is the plus sign. So, if I want to add here, 6 and 4, I simply have to write down here 6 plus 4, which is equal to 10. And you can see this is the screenshot and here you can see here I am writing here, this hash command, so, it is not executed because whatever is reading after the hash sign, that will not be executed.

And similarly, if you want to do the multiplication of two numbers, that will be here, 6 into 4. So, the multiplication sign is a star sign like this one. So, this will give you the multiplication of two numbers.

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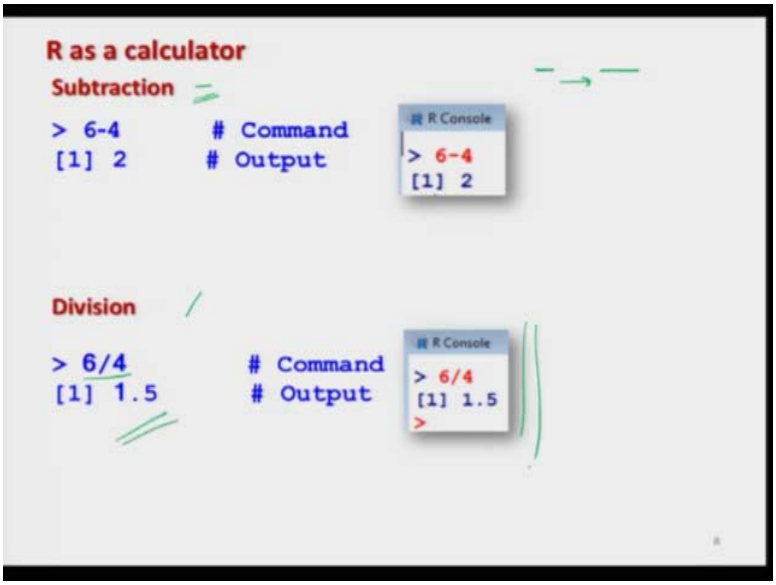

And similarly, if you want to subtract two numbers, the sign here is the usual sign of subtraction that is hyphen, but you have to be careful when you are trying to do the score. Suppose you are trying to copy command from the PDF file of this course, then you have to be a little bit careful. I have prepared those slides in the PowerPoint. And one thing happens in PowerPoint that when I am trying to type this minus sign, and as soon as I move forward, the sign of this subtraction sign becomes bigger it will become like this. That looks more beautiful, but then it is not really a mathematical subtraction sign.

So, sometimes when you are trying to copy and paste the command from the PDF file and trying to execute it on the R console, it may give you some error. So, in those cases, try to be careful that one possibility is that the minus sign which is looking or appearing as a minus sign to you, it is not actually a minus sign, but it is some other symbol, which the software has converted automatically to something else. So, my suggestion will be that in order to solve the problem, simply try to type the command, say minus inside the R console so that will help you.

So, the moral of the story is that the subtraction sign is only here this subtraction sign usual. And if you want to divide two numbers, the division symbol is a backslash. So, if you want to divide 6 by 4, you simply have to write down here 6 backslash 4, and the answer will come out to be 1.5. And this is the screenshot that is pretty simple, it is not a very difficult thing.

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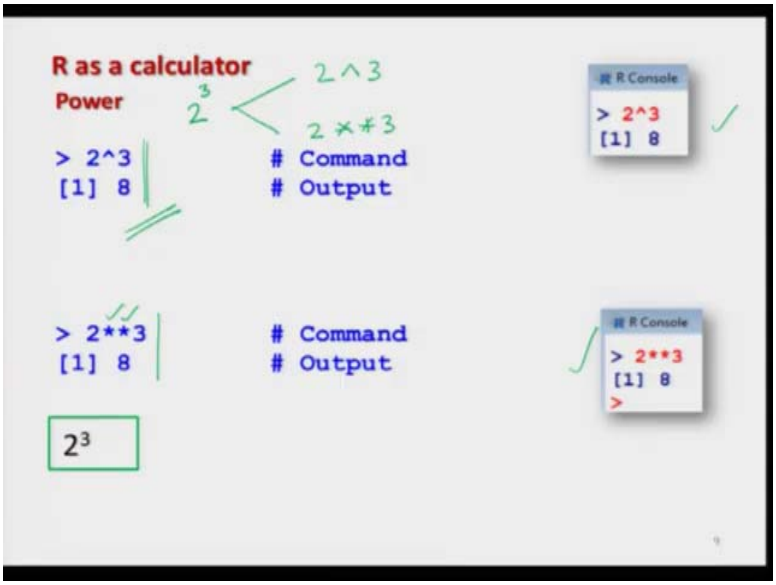

And similarly, if you want to use the power operator, like as if you want to write down 2 raise to the power of 3 that is 2 cube, then you can write this thing in two possible ways. One option is this you try to write down 2 hat 3 and hat is a symbol that is available on your keyboard or you try to write down here 2 and two stars that you have to make here, double stars and 3. So, both are going to give you the same outcome. So that is up to you whatever you want to choose.

So, if you try to say here 2 cubes, you have to simply write here 2 cube 3. And you have to write here 2 hat 3 which is equal to here 8 or the same thing you can write down here 2 star-star 3 and this will also give you here the value 8 and these are the screenshots here. So, these are not very difficult things for you to understand.

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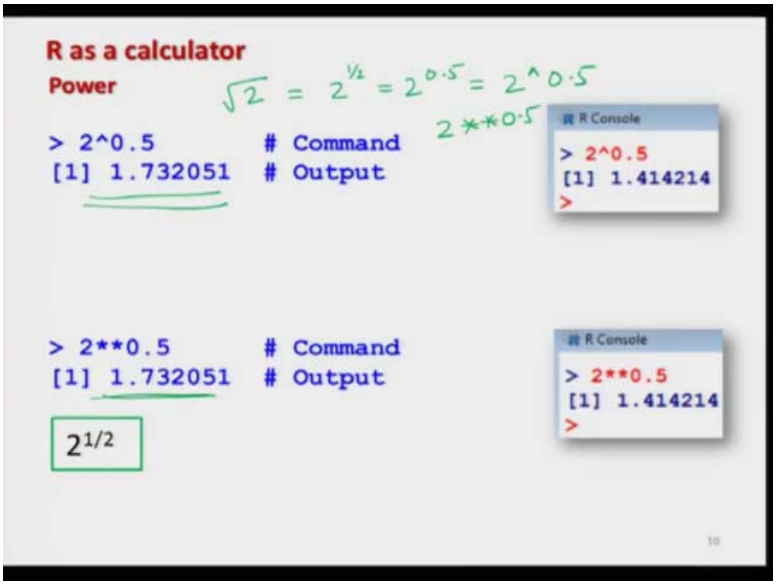

And similarly, if you want to write down. Suppose, I want to find out the square root of 2. So that we know from the mathematical tool this is going to be 2 raised to the power of 1 upon 2 which is 2 raise to the power of 0.5. So, this I can write down here 2 hat 0.5 or I can also write down, 2 double star 0.5. So, whatever you want you can do it. So, the power operators also work when the powers are in the form of some fractions also that is what I wanted to convey to you. So, both these things are possible.

So, this is how you can find out the square root of 2 this is 1.73 or 2 double star 0.5 it will also give you the value of a square root of 2, that is not difficult I know it.

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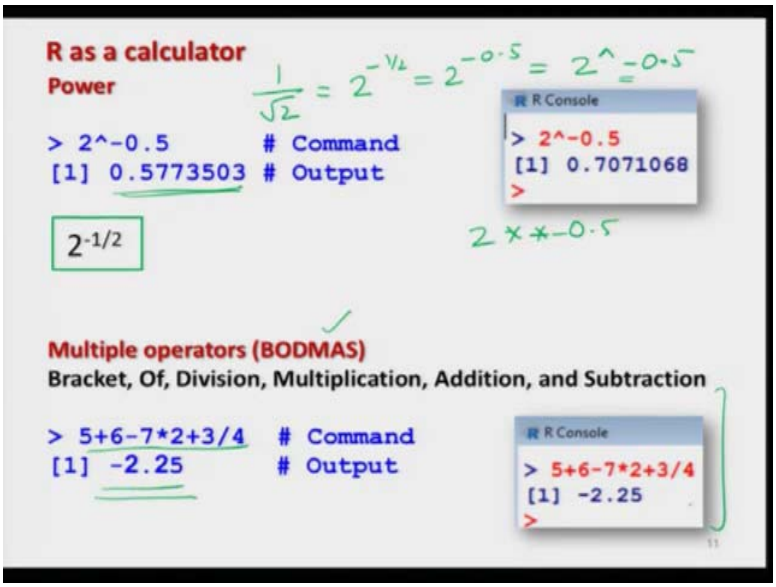

And similarly, if you want to know the value of 1 upon the square root of 2, then this is actually to raise to the power of minus 1 upon 2 which is equal to 2 raise to the power of minus 0.5. And so, this I can write down here 2 hat minus 0.5. Well, this is possible. We are here with a minus sign is along with the hat sign or you can also write down here 2 double-star, say here minus 0.5. Those things are possible and this will give you the value of 0.577. Well, it is not difficult.

And besides those things, all other mathematical operation, which is the BODMAS rule, that is the brackets, of, division, multiplication, addition, and subtraction. Whatever you have learned in your elementary classes in arithmetic, they will also be valid, that if you try to write down a combination of the numbers with different mathematical operators, they are going to be solved following the rule of BODMAS.

So, if I try to write down here 5 plus 6 minus 7 into 2 plus 3 divided by 4. In case, will be solved using the rule of BODMAS and it will give you the value here minus 2.25. So, these are the screenshot here, but just for the sake of completeness and confidence, I will try to show you these operations on the R console also.

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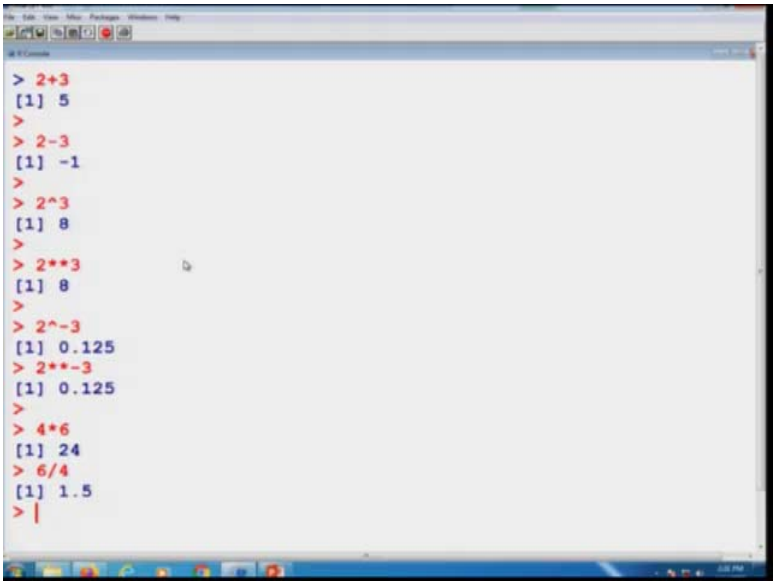

So, first, let me try to clear the screen by Ctrl L. And then suppose if I see here, I want to find out here 2 plus 4, you can see here this is simply 2 plus 3 and if I want to do the subtraction 2 minus 3, this is 2 minus 3, which is minus 1, and if I want to find out here 2 cube. So, this is coming out to be here 8 and the same thing I can find out by writing 2 double star 3, which is

here you can see here 8 and if I want to find out here 1 upon 2-cube. So, this I can write on 2 hat minus 3, and you can see here this is 0.125. You know that 1 upon 8 is 0.125. And the same thing I can write down by typing 2 double star minus 3, you can see here this is 0.125.

And similarly, if you want to multiply two numbers. Suppose, I want to multiply here 4 into 6 which means, I want to multiply 4 and 6. This is 4 into 6 which is 24. And if I want to divide 6 by 4, so this will be 6 backslash 4, this is here 1.5.

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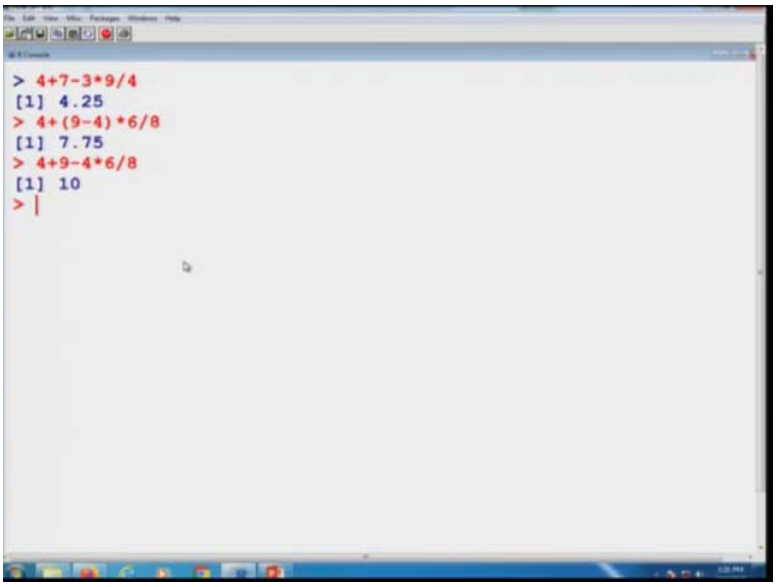

And similarly, if you want to use any BODMAS rule 4 plus 7 minus 3 into 9 divided by say here 4. These things can be there and similarly, the brackets are also there, but when you are trying to use the bracket. The brackets are only the simple parentheses are allowed, the curly bracket and the square bracket are not allowed for the mathematical operation. For example, if I want to write down here 4 plus say here back at 9 minus 4 into 6 divided by here 8. So, first, the brackets are going to be solved and the answer is going to be like this. And if you try to remove here the bracket sign and then try to see the outcome, this is going to be different.

So, whatever are the rules that you have learned in your elementary classes in arithmetic they are going to be valid. So, now we come to an end to this lecture. So, in this very elementary lecture, I have given you a quick and refreshing idea or the basic information about the mathematical operator that how can you do the addition, division, multiplication, subtraction, etcetera. These are very simple things, but this is the information that I will be needing when I am coming to my classes or my lectures on statistics.

So, I would request you, that you try to practice them and in the next lecture, I will try to give you a quick review of the simple operations, simple mathematical operation which are based on the vectors, data vectors. So, you try to practice it and I will see you in the next lecture once again. Till then, goodbye.