Lecture 05

Calculations with R software _Operation with matrices

Welcome to the collection on the coursed descriptive stats 6 with R software in the last couple of lectures. We have understood that how R is going to be useful for doing various types of mathematical operations, and we also understood that how the missing data of values can be handled inside the R software. Now in this lecture I will try to give you an idea that how to handle metrics in R software .so, what is the matrix?

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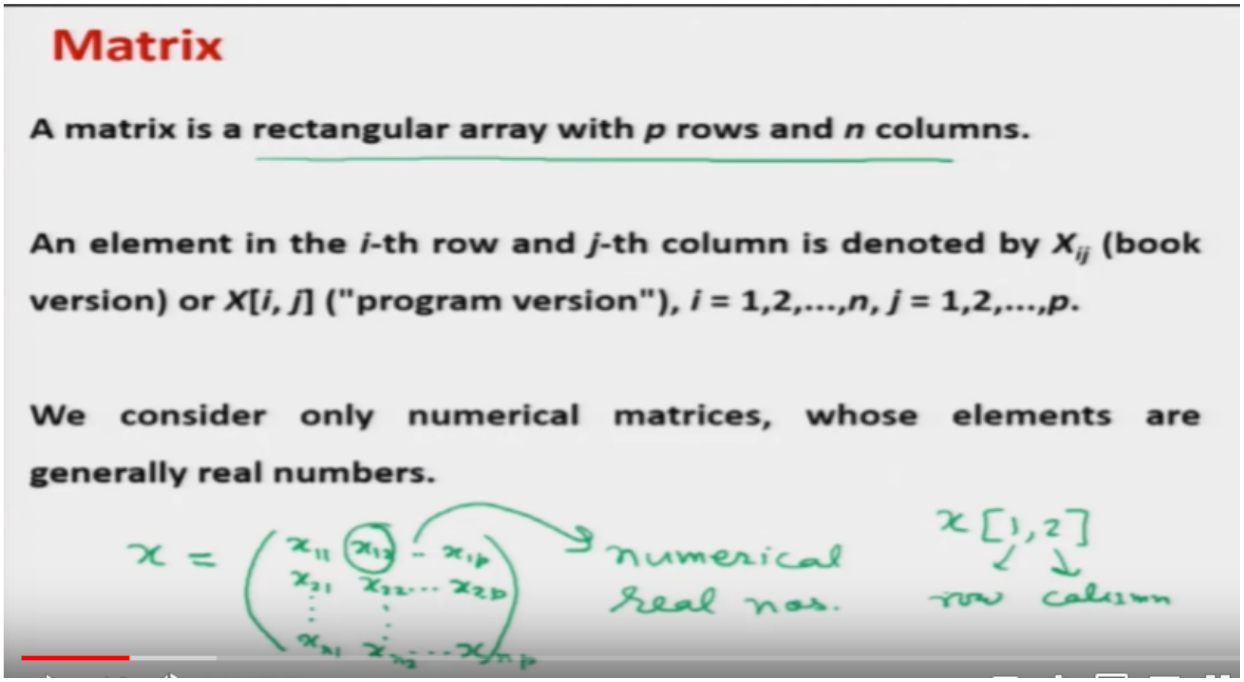

If you try to see from the mathematical point of view matrix is simply a rectangular array, which has got P rows and say n column and this will be denoted as a matrix of order P cross n for example I can always write a matrix like here X is equal to that's a standard notation X 1, 1 X 1 to say here X 1 say here P and Quentin sa here X 2 1 X 2, 2 up to here X say N 1 and X 2 to here and something like here X 2 P 2 P and then X n 2 and say here X n P. Right? So, this is here a matrix and what we are going to assume? That here all these values are some numerical value some real values. Right? So, I will say that all these entries in the matrix are some numerical values there are currently some real number. Right? And in case if I want to denote a particular element for example if I want to denote this X 1 2 So, X 1 2 is going to be denoted like X 1 comma 2. So, that means this is the element on the first row and in the second column. So, a question arises here what is the difference between data vector? And vector in terms of metric theory data vector is a negative vector but in a matrix theory we have a number one different commands and it has a different structure. So, first you have to decide that whether the data has been inserted in the form of a Decatur vector or in a form of vectors and matrices both these operations are going to be different that is what we are going to see in their for their lectures.

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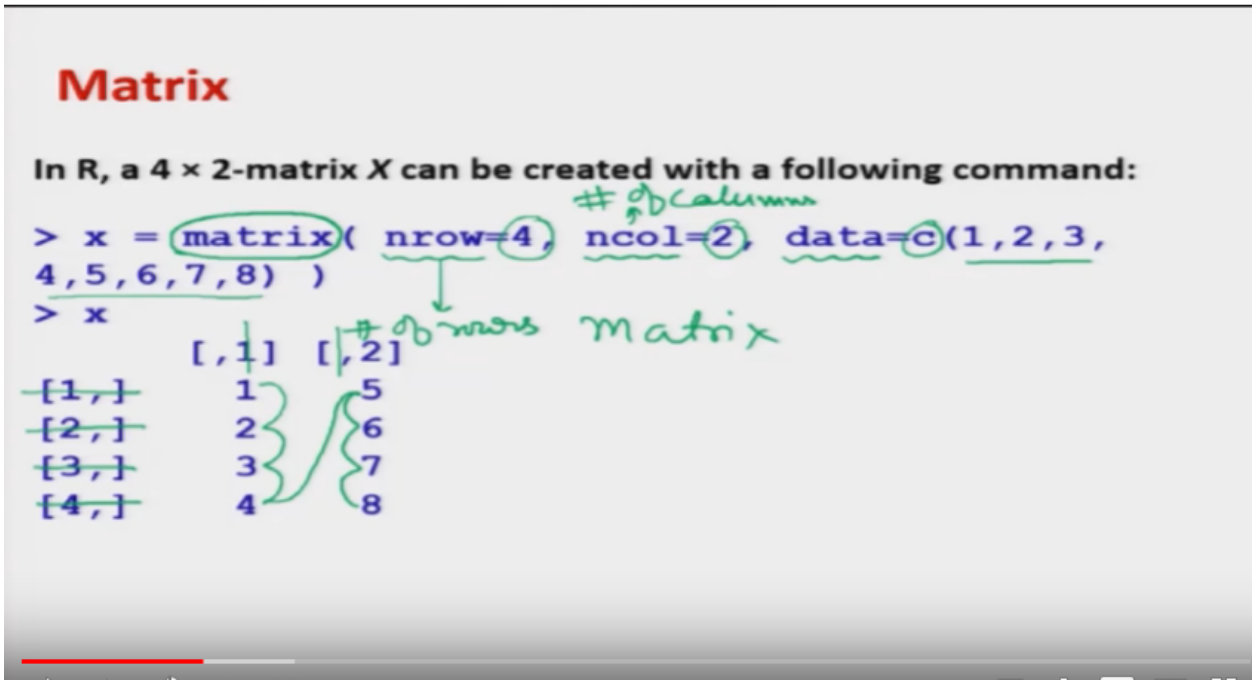

So, the first question comes how to create a matrix? So, in order to create a matrix we have a command here a matrix, matrix and inside the bracket you can see here I am writing here several thing and row and call data. So, this n Row is trying to give me the information that how many rows I want so, this is giving us the information on number of rows n call is similarly it is trying to give us any information that what are the total number of columns in the matrix. And what data has to be given? This has to be given using the C command inside a data vector that has to be arraigned inside the matrix. So, here if you try to see I am using here and row is equal to 4 that means the number of rows are here 4. And number of columns this is here too so, there are going to be 4 into 2 that 8 values in the data vector. So, I'm trying to write those values here 1 2 3 4 5 6 7 8 so, now the data is going to be arranged in four rows and two columns. So, you can see here there are 4 rows 1 2 3 4 and there are two columns here 1 and 2 and data is going like this 1 2 3 4 and then from here 5 6 7 and here 8. So, yes there can be a quotient that way why this the data is going to be column wise or white cannot be row wise. So, that I will try to address but here at this moment I would request to you please try to observe how the matrix has been created. I have simply given the number of rows number of columns and the data and based on that our matrix of order 4 by 2 has been created. Right? And because, for your remembrance

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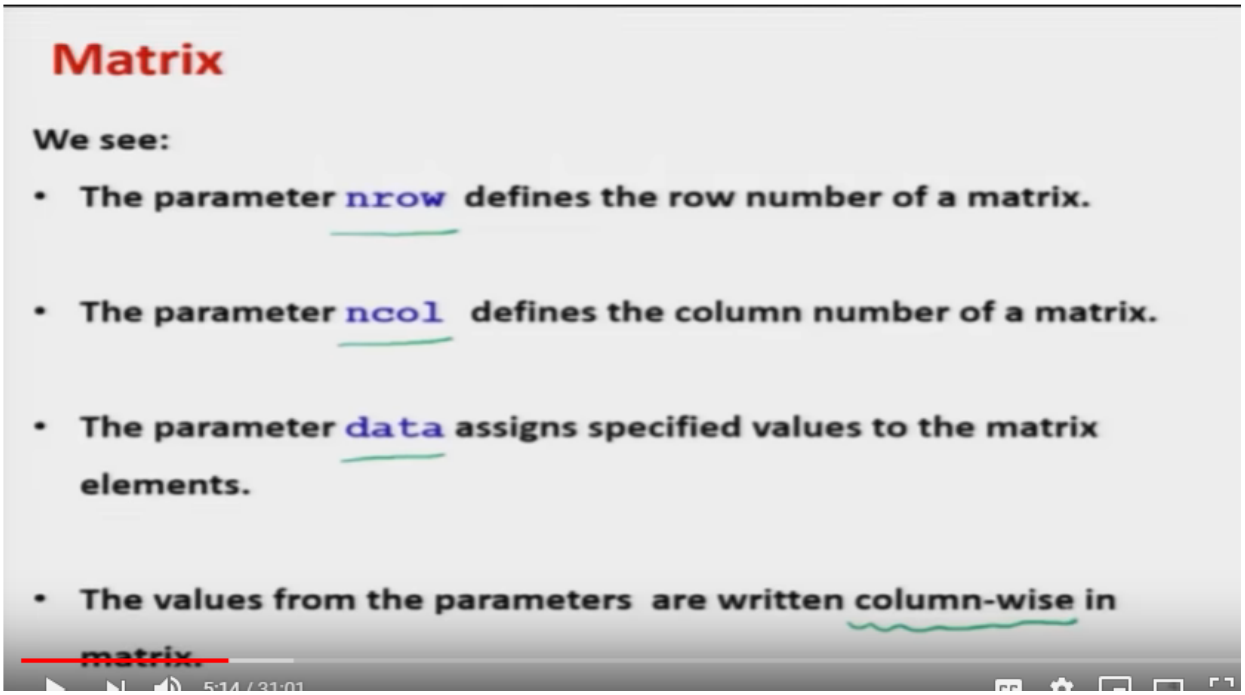

The parameter n roll' define the number of rows in a matrix the parameter n called defines the number of columns in the matrix and the parameter data defines what data has to be given inside the matrix. Right? And usually in case if you are not giving any option whether the data has to be entered in row wise or say column wise the default is column wise as we have seen in the earlier slide.

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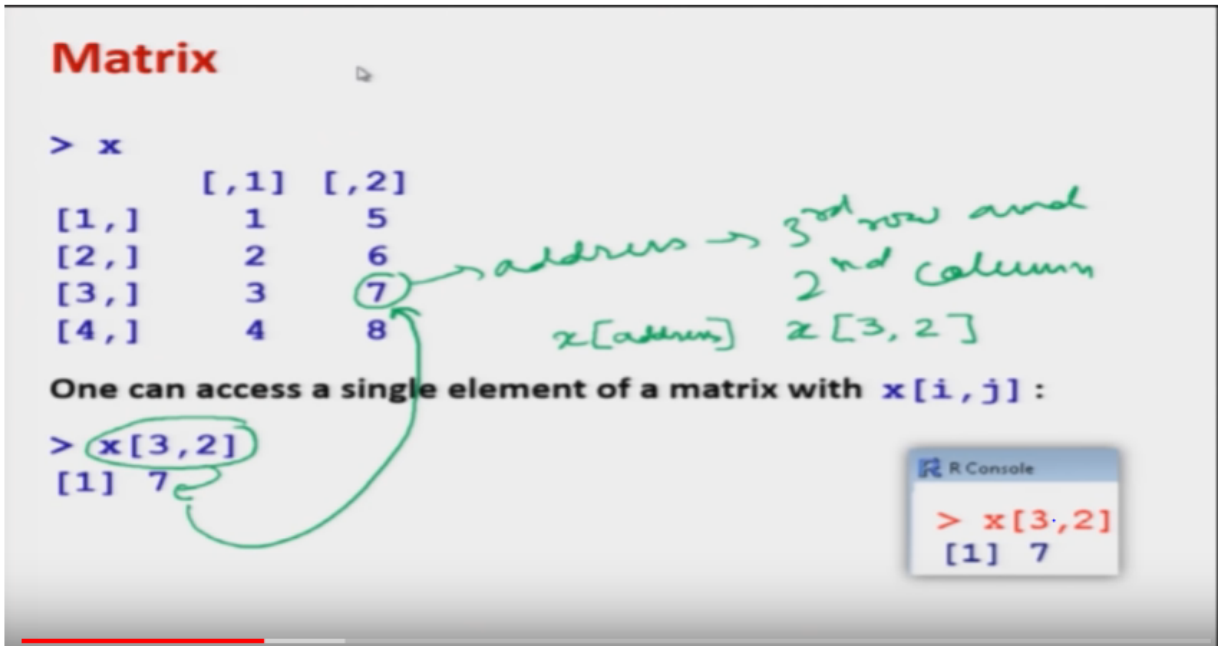

So, now I'm going to consider here the same matrix here X which I have just denoted and suppose my issue is this suppose my query is this I want to access a particular element. So, how to obtain a particular element? Suppose I want to obtain this element 7. so, now what is the address of 7 the address of 7 is this, this is located in the third row and second column so, I will try to write down here the name of the matrix small X and inside this square bracket I will try to write down the address. So, in this case this address is going to be X bracket 3 comma 2. And once I try to type X 3 comma 2 on the R console I will get here the value 7 which is the same value here like this .so, before I go further I would try to show you that how the things are going to happen on the R console so I will try to create the

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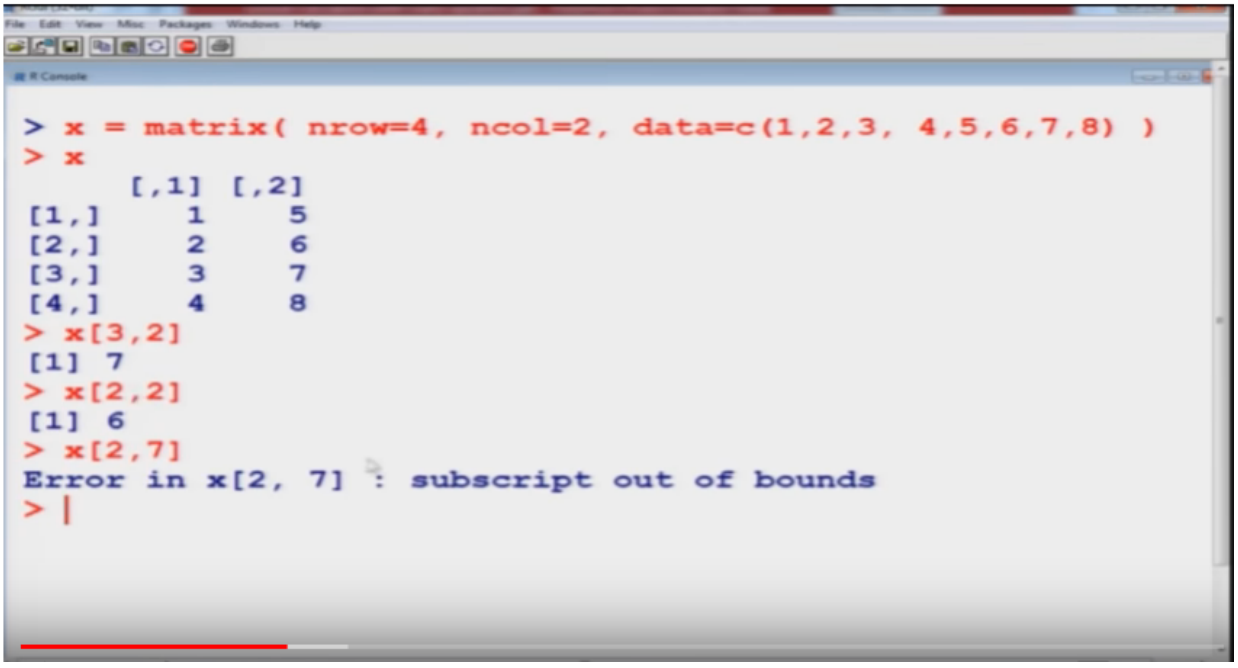

Same matrix here and you can see here the Chris is here the matrix X. Right? And suppose if I want to obtain a particular element say 3 comma 2 I am getting here 7 so, this 7 correspond to this thing similarly if you want to find out the see here 2 comma 2 this is 6 but if you try to find out here 2 comma 7 you can see here that this value does not exist here. Right? Okay?

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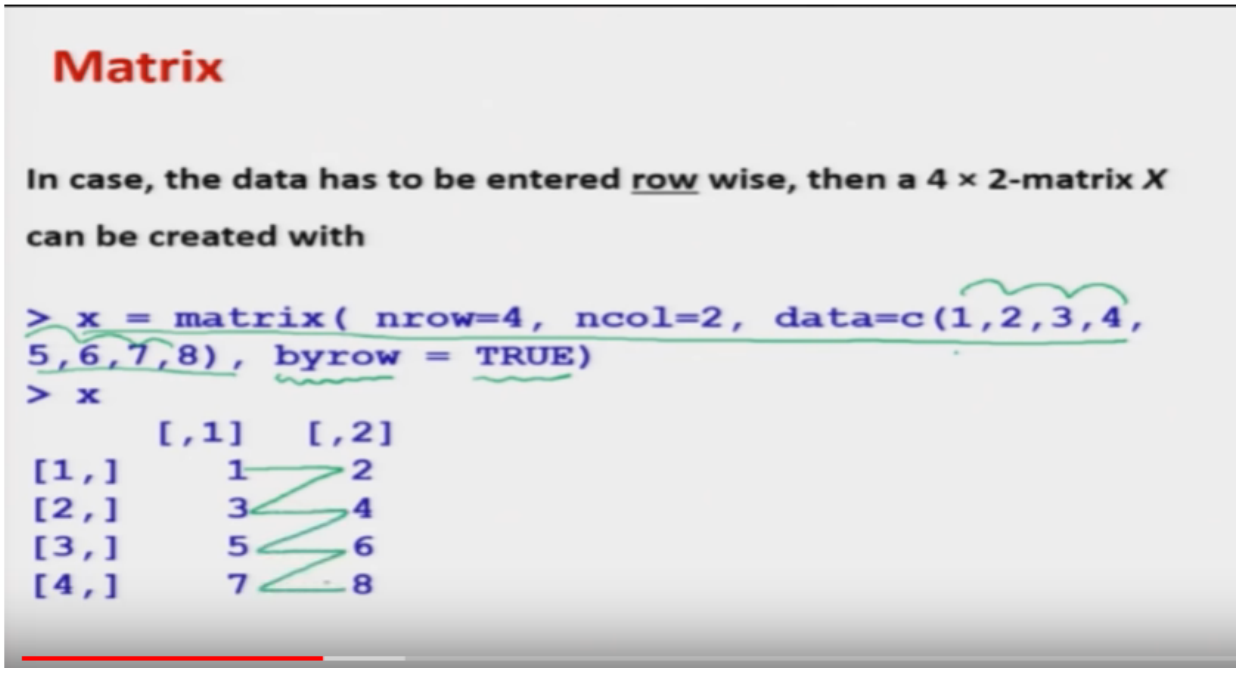

Now I try to address here the second issue that in case if you want to enter the data row wise. Then what option you have to give you simply have to give an option here or add a parameter here by row is equal to true. So, you can see here I mean all other part of the syntax is the same what we use in the earlier slide? But I have used here one thing by rule is equal to true. And in this case you can see that data 1 2 3 4 5 6 7 8 this is going to be entered like this 1 2 3 4 5 6 7 & 8 .Right?

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So, this is how we try to do and this is the screenshot I will try to show you on the screen also on the R console also

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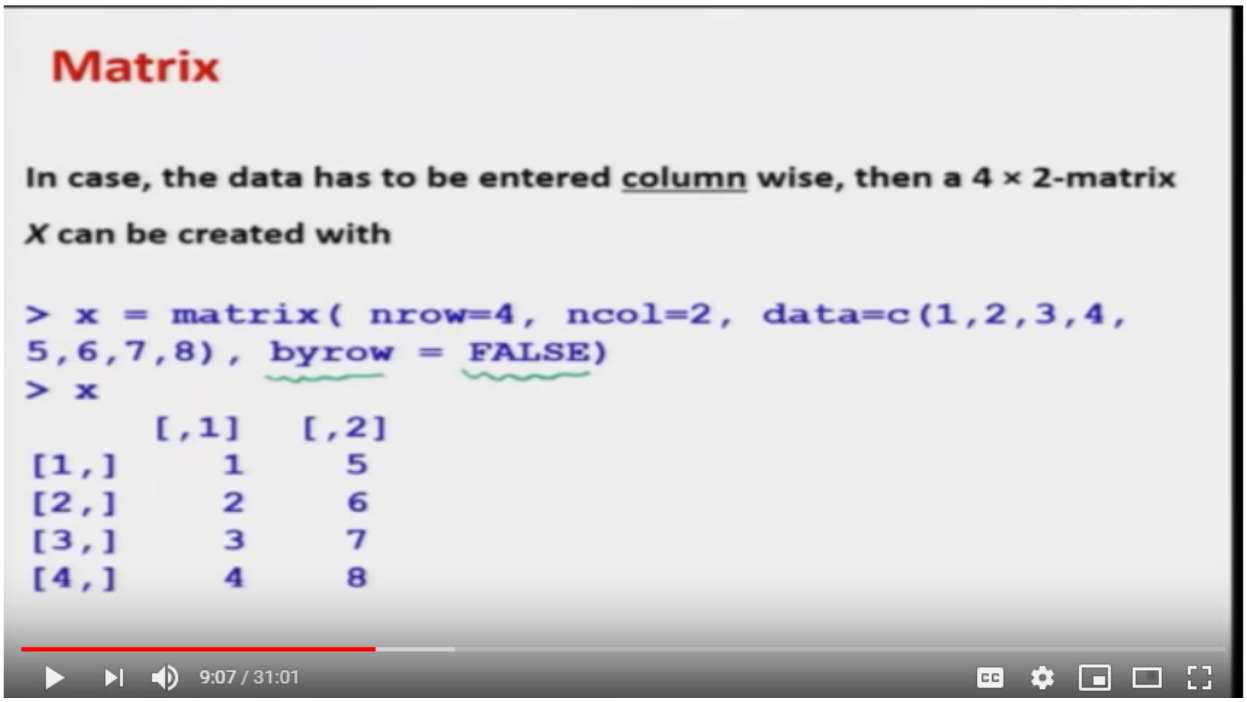

And similarly in case if the data has to be entered column wise then I simply have to add the parameter here by row and which is now here false that means I don't want the data to be entered in the row wise mode. So, obviously once this statement is false because, then the opposite is true that the data has to be entered by column wise. So, in case if I try to execute these things over the R console I can show you here so if I try to use here by equal to here false I should pick a note my phone size here so that you can see it here clearly you can see here you can reduce this phone size here and you can see here that this is here by row is equal to false. Right? and now in case if I try to see what is here X this is the same thing but now in case if I try to do the same thing and if I try to make it here true other kind I can use it capital T also here now you can see what, what is the outcome ?here the data here in the first case and the data here in the second case these are arranged in a different ways first in the case of column wise and then the second case it is row is Right?

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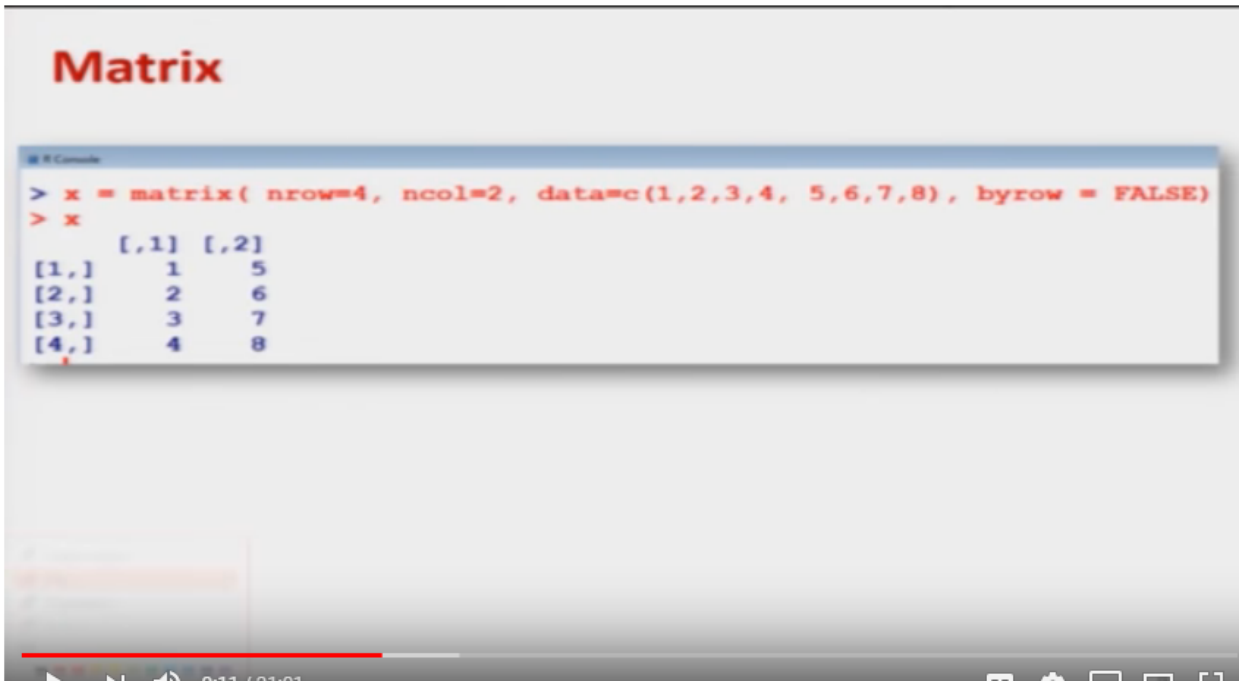

So, this is the screenshot of the same operation for your information only

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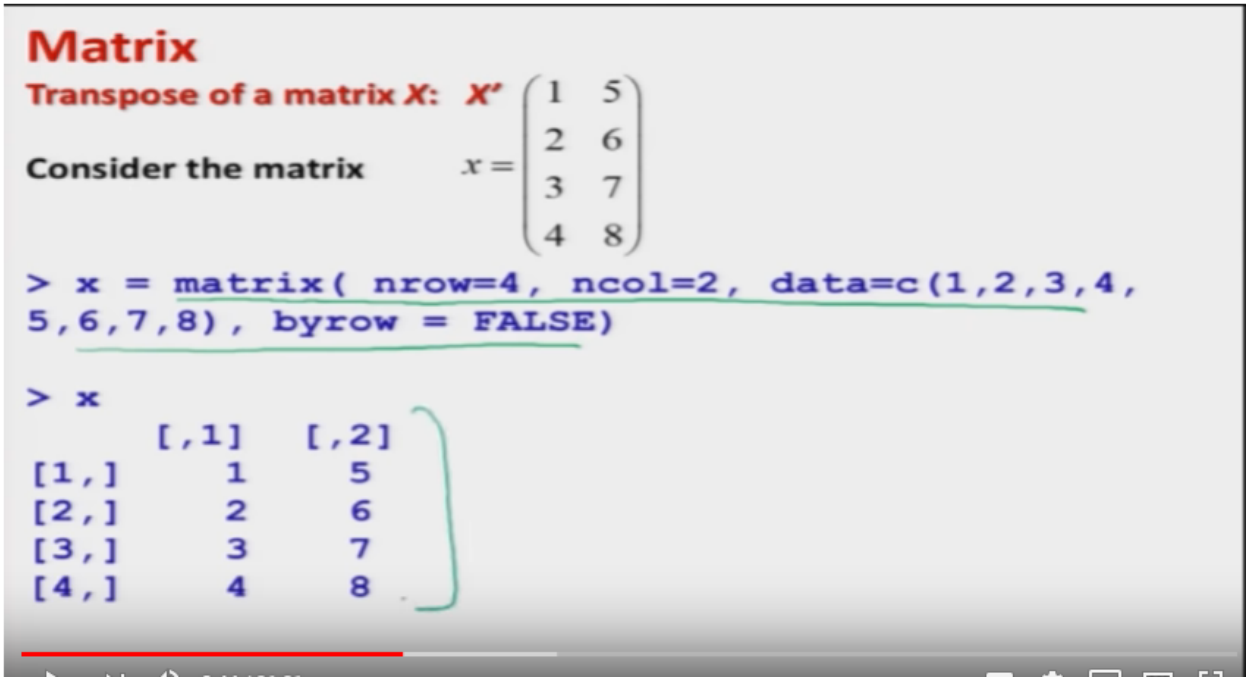

And similarly if I want to find out the transpose of a matrix what is the transpose of a matrix? when we try to interchange the rows and columns then it is called the transpose, for example if I say I have here a matrix here is equal to 1 5 2 6 3 7 4 8 then this matrix can be given in R console using this command matrix and by the same command that we have used earlier and its outcome will like this. Now in case if I want to find out the transpose

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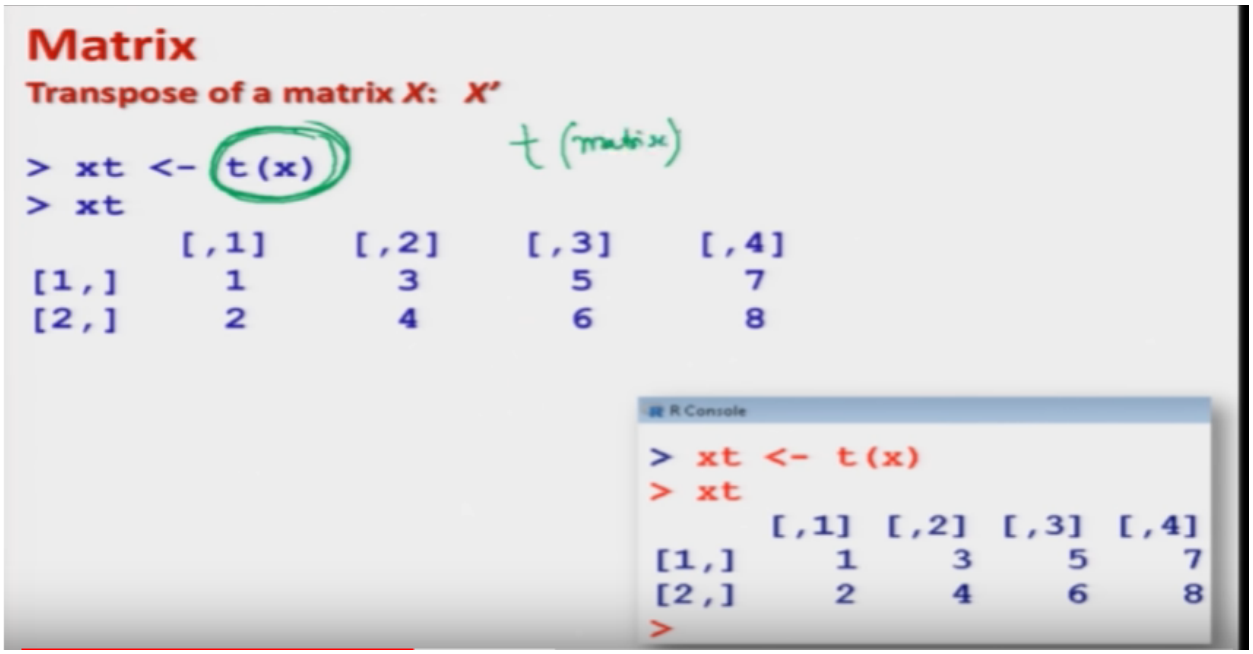

The command to find out the transpose is here TX mean t means a transpose and inside the bracket you have to give the name of the matrix of which you want to find out the transpose. So, you can see here you're earlier

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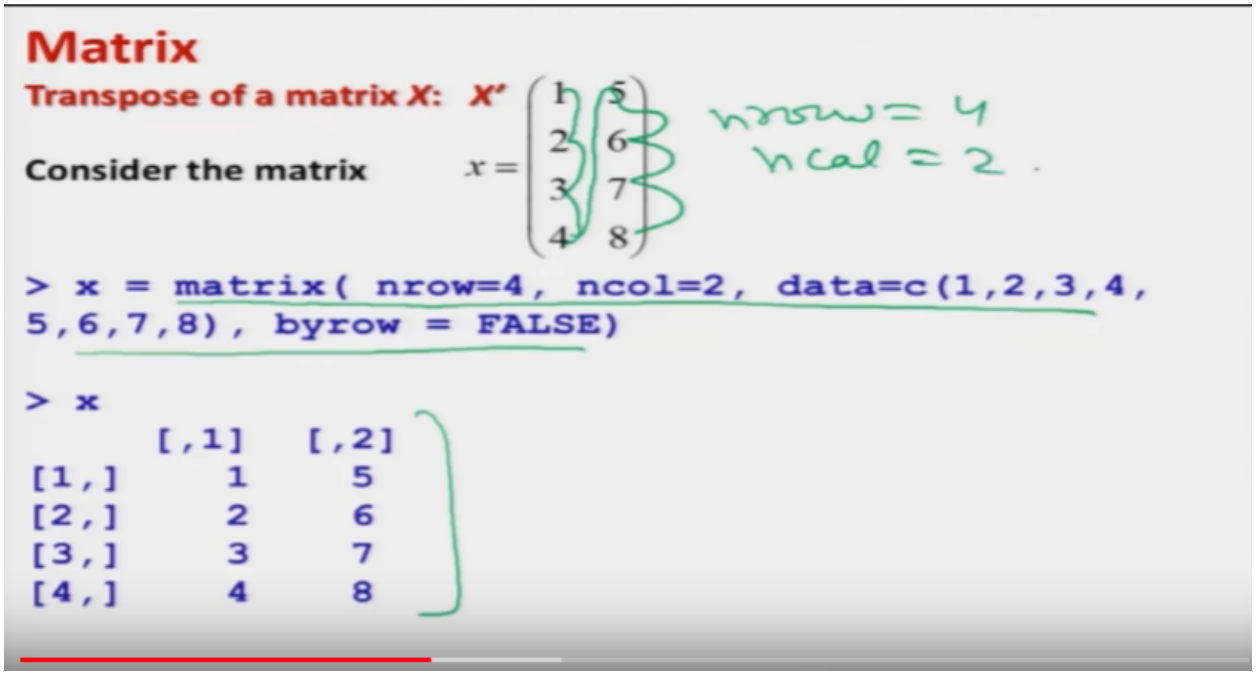

This matrix was 1 2 3 4 and then here 5 6 7 and here 8. But now this number of rows and number of columns are chained here the number of rows are here for and number of here columns are here too but now once I try to find out

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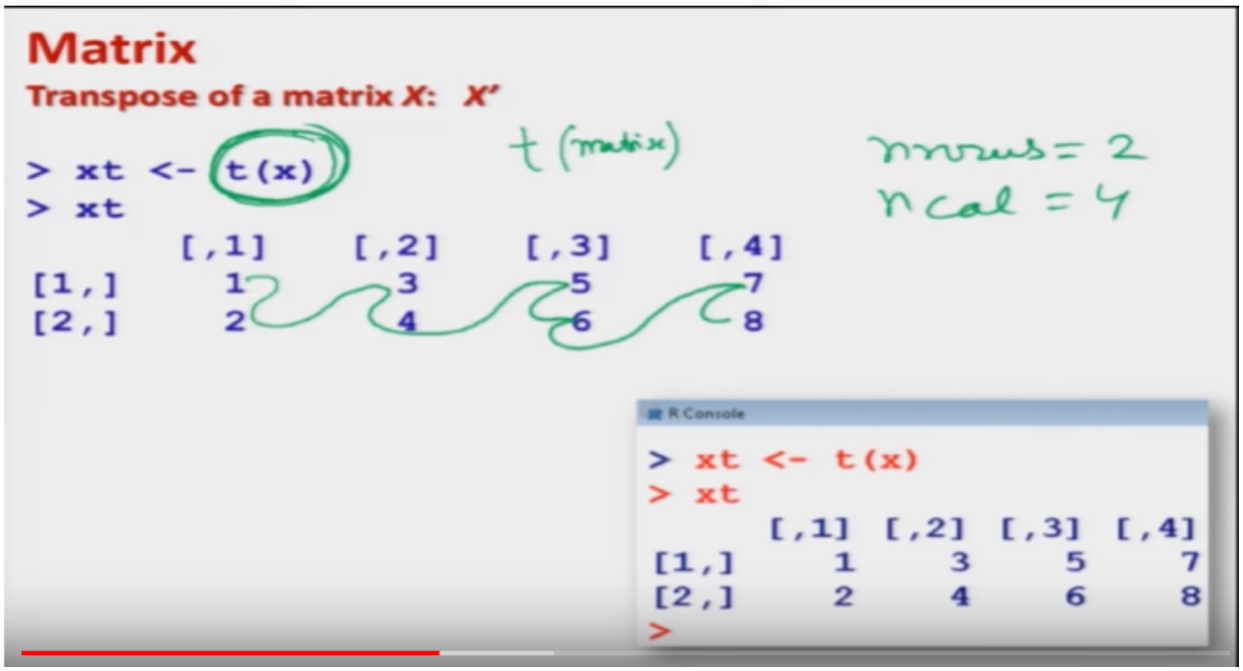

That transpose the number of rows, they are here too and number of columns here are here four and the data is now say 1 2 3 4 and then 5 6 and then Hill 7 and here 8. So, this TX is the command to find out the transpose of a matrix in R and now I would try to show you on the R console also for example if I try to take a the same matrix that we had taken earlier. So, here you can see here the crease is you here X matrix and if I try to find out the transpose of a T of up here X .Now this is your change this first row this becomes first column, second row here becomes second column, third row here becomes third column, fourth row becomes here fourth column. So, this is how we can find out the transpose of a matrix

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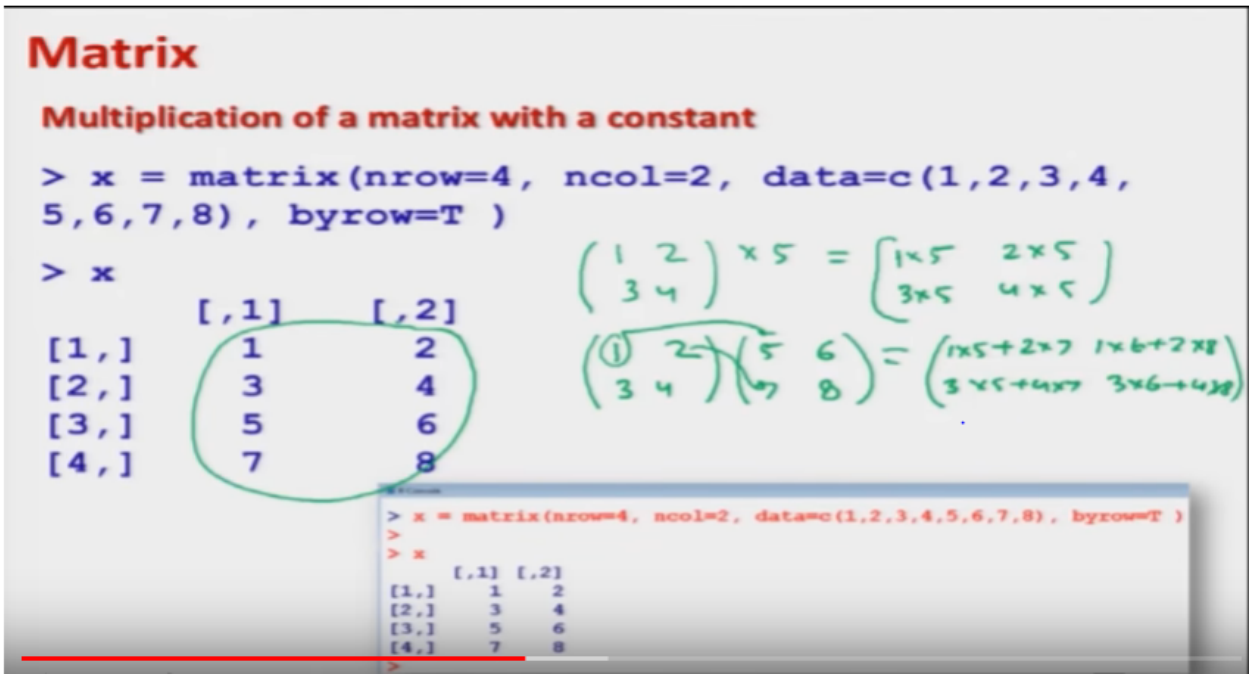

Now next I try to address that how we are going to use the operations of matrix addition and subtraction in matrix setup. So, we know that in matrix if I have a matrix like here 1 2 3 4 and if I try to multiply it by here a scalar 5 then this operation is done on each and every operation, say I say each and every element. So, 1 into 5 2 into 5 3 into 5 and 4 into 5 and now, in case if I try to make it here the multiplication of a matrix with say another matrix, then this is given by 1 into 5, plus 2 into 7, 1 into 5, and 2 into 7 multiplied it. And then add it then again 1 into 6, plus 2 into 8, 3 into 5, plus 4 into 7, and then 3 into 6, plus 4 into 8. So, this is how the multiplication is done in mathematics and this is what is taught to all of us. So, now in this case I try to take here the same matrix here. Which is here in which the data vectors are 1 2 8

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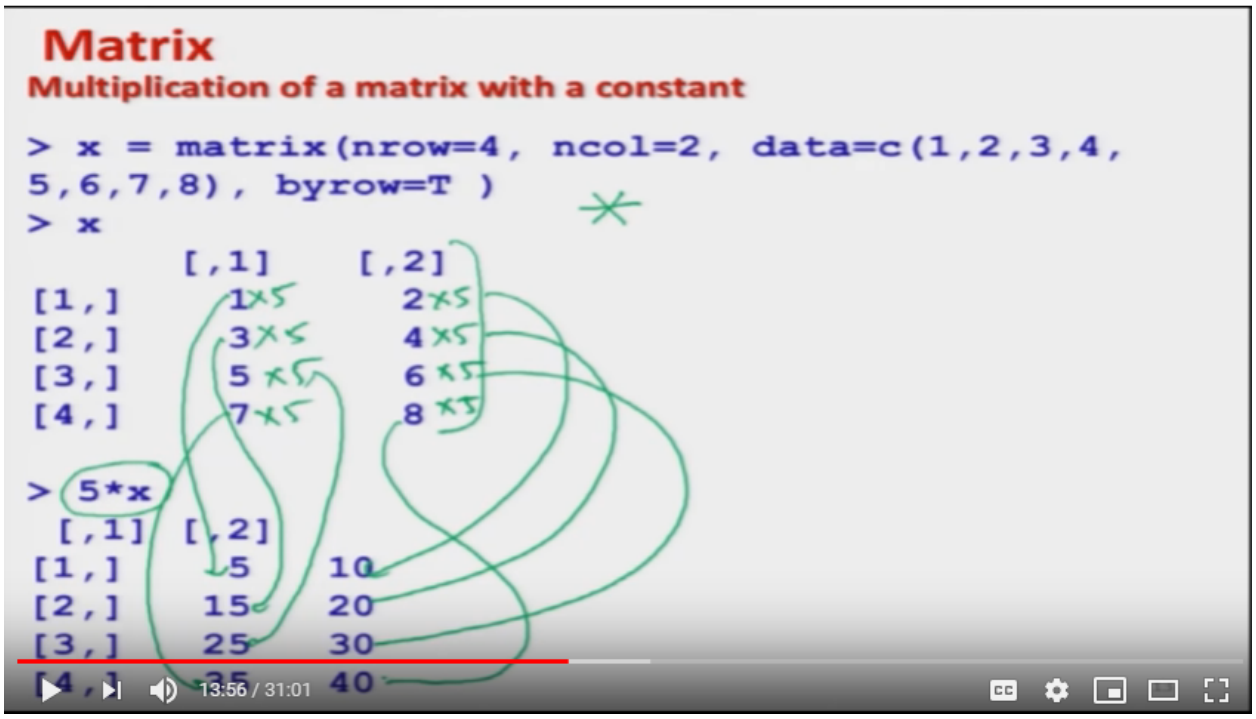

And now in case if I try to multiply this matrix by here 5. So, the operator what you have to learn here, is star this is the same operator what was used for multiplication. So, remember when you are trying to multiply a matrix by a scalar then the operator is only star. When you are trying to multiply matrix by a matrix then I will have a different operator. So, in this case if you try to see here if your X matrix is like this and if you try to obtain here 5 into X then you can see here that this element is multiplied by 5 this element Right? By 5 this element is multiplied by 5 and each and every element is multiplied by 5 and here you are getting the outcome 1 into 5, 3 into 5, 5 into 5, 7 into 5, 2 into 5, 4 into 5, 6 into 5 and 8 into 5 that is 40

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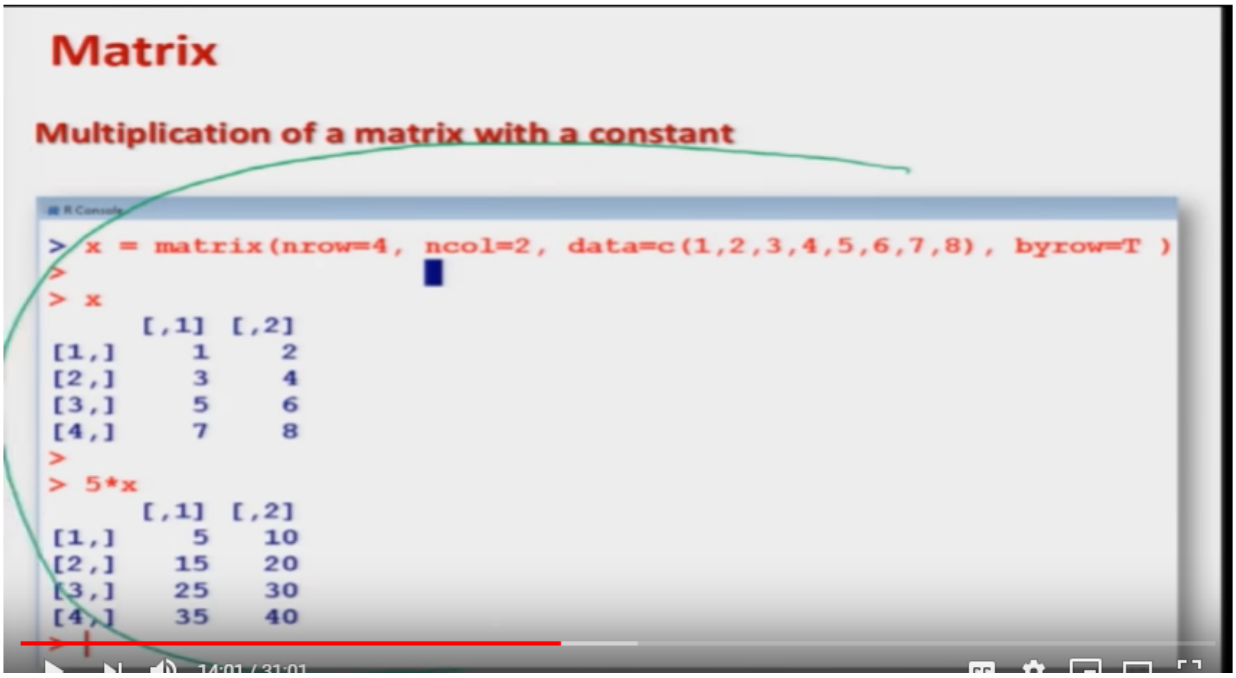

And here is the screenshot of the same thing. So, I will try to show you here it on the R console also

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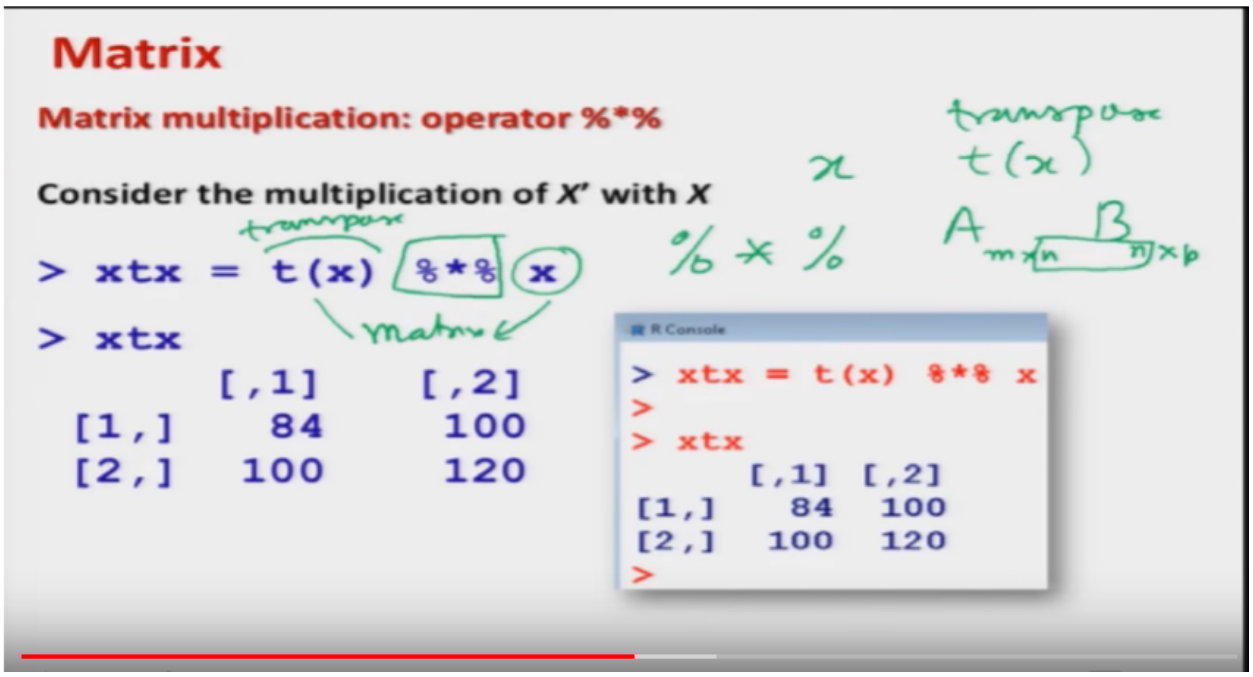

Now you can see here this is your here X and now you are trying to make it here 5 into X .so, you can see here that every element has been multiplied by 5. And now I'm trying to consider the multiplication of a matrix by a matrix. So, you already have created a matrix here X and you already have created a matrix here transpose of X that is already there so, I would like to utilize that thing. Right? So, now I am trying to multiply the transpose of a matrix X with matrix here X and now you can see here this is the operator. So, this is a matrix and this is a matrix so, one when you are trying to multiply a matrix by a matrix of suitable order then you have to use the operator percentage multiplication and percentage and remember one thing means all those rules for the matrix multiplication from mathematics they have to be satisfied here for example if you have here two matrices a and B they can be multiplied only if their orders are like this a if a is of order M cross n then B has to be of order of say n cross P. so, these two orders have to measure otherwise this won't be valid so this is how we try to do it here and you just I would try to show you on the R console also

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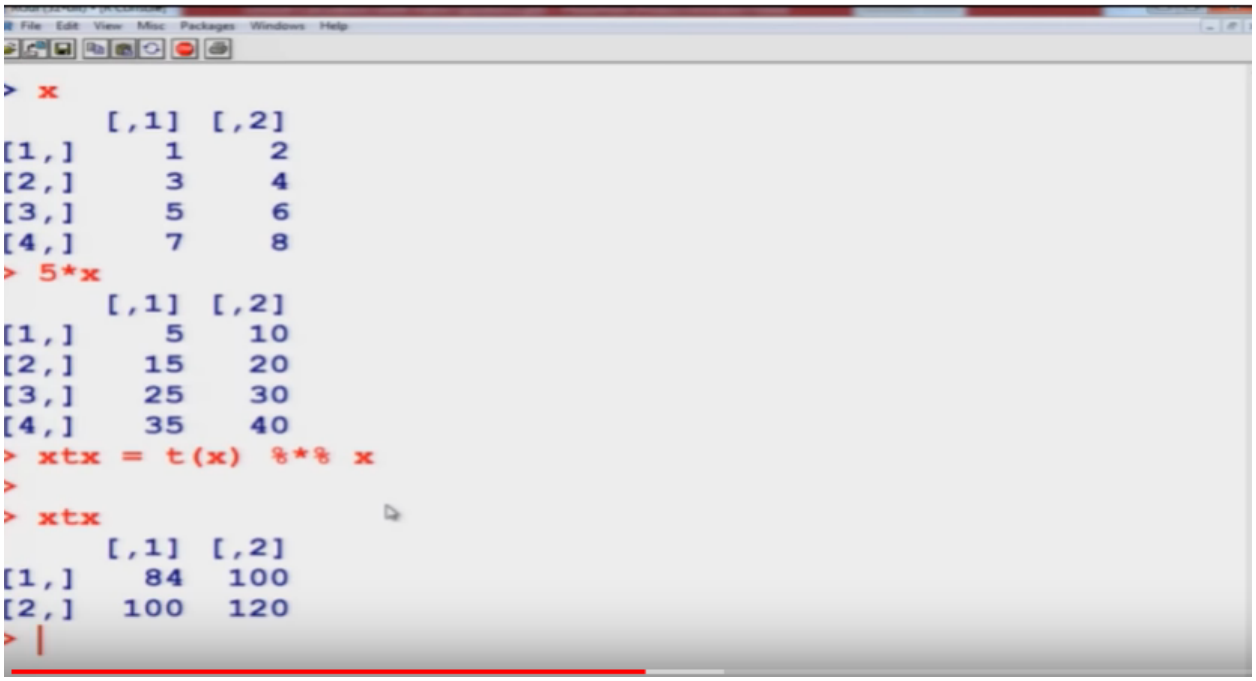

And if I try to show you here so, this you can see here xtx will come or to be like this

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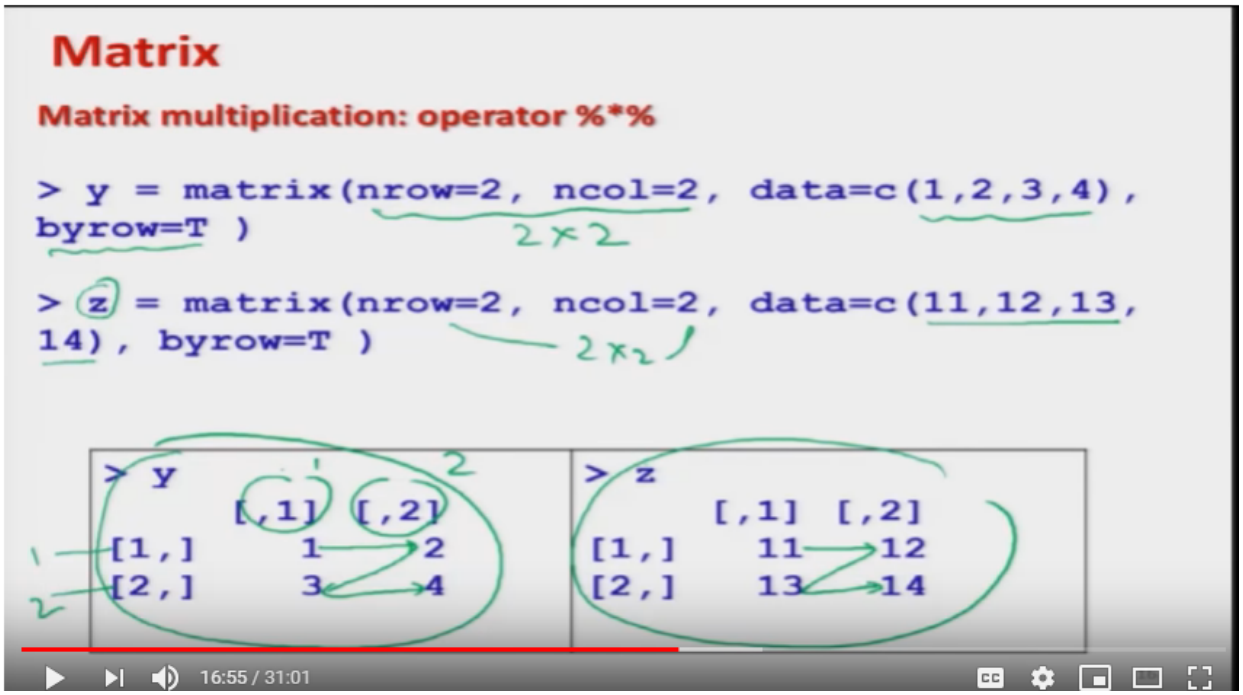

Now I will try to pick here some more examples to make you understand. And suppose I try to take here say here two other matrices which are they are just methods of order two by two and whose data values are 1 2 3 4 and data has been entered by putting the parameter by it was equal to true. Right? So, in case if you try to insert that the data this outcome will come out to be like this here there are 2 rows 1 2 & 2 columns 1 and here 2 and the data here is entered by row 1 2 and then 3 4 and similarly I try to take another data set 11 12 13 14 and on the similar lines I try to create here another matrix of 2 by 2 and I call it here as a Z. so, this matrix will look like this the data will be 11 12 13 14 and so, now I have here 2 matrices of order this 2x2 and I will try to show you that how to multiply them so, Right? So, you can see here there are two matters here Y and here Z and if I try to multiply here Y percentage star percentage you get here like this. Right? Yeah and here is the screenshot of the same operation for your understanding. So, this is here Right?

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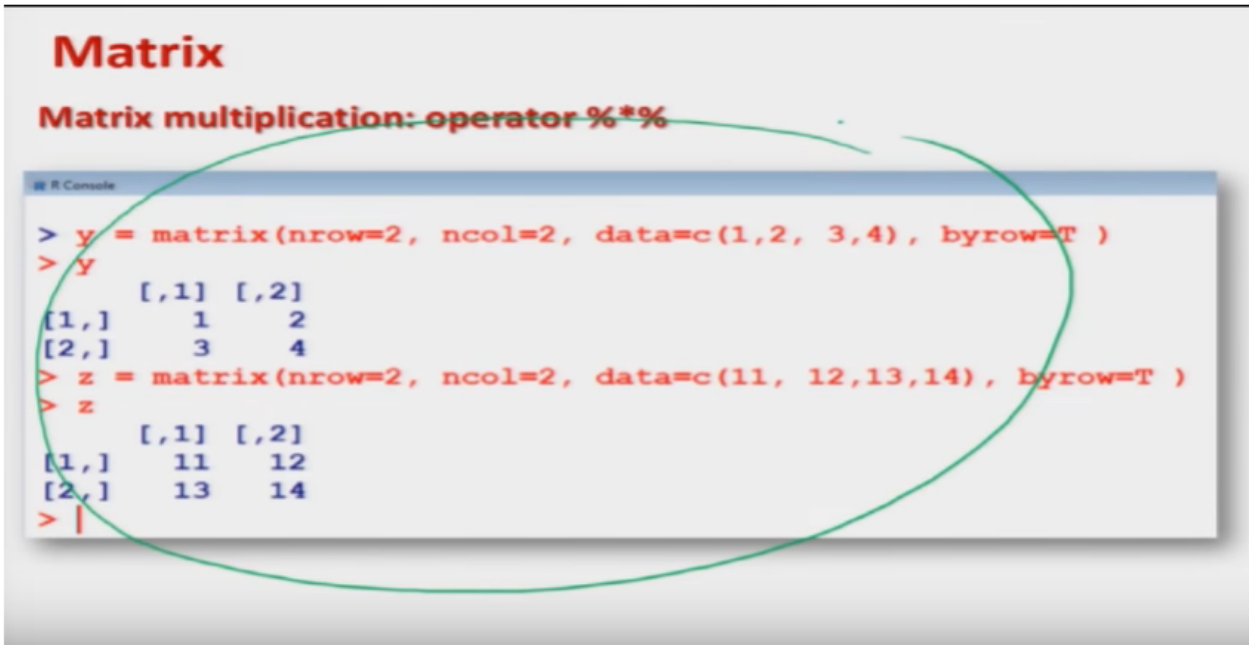

And this is again the same screenshot, which has been obtained over here .Right?

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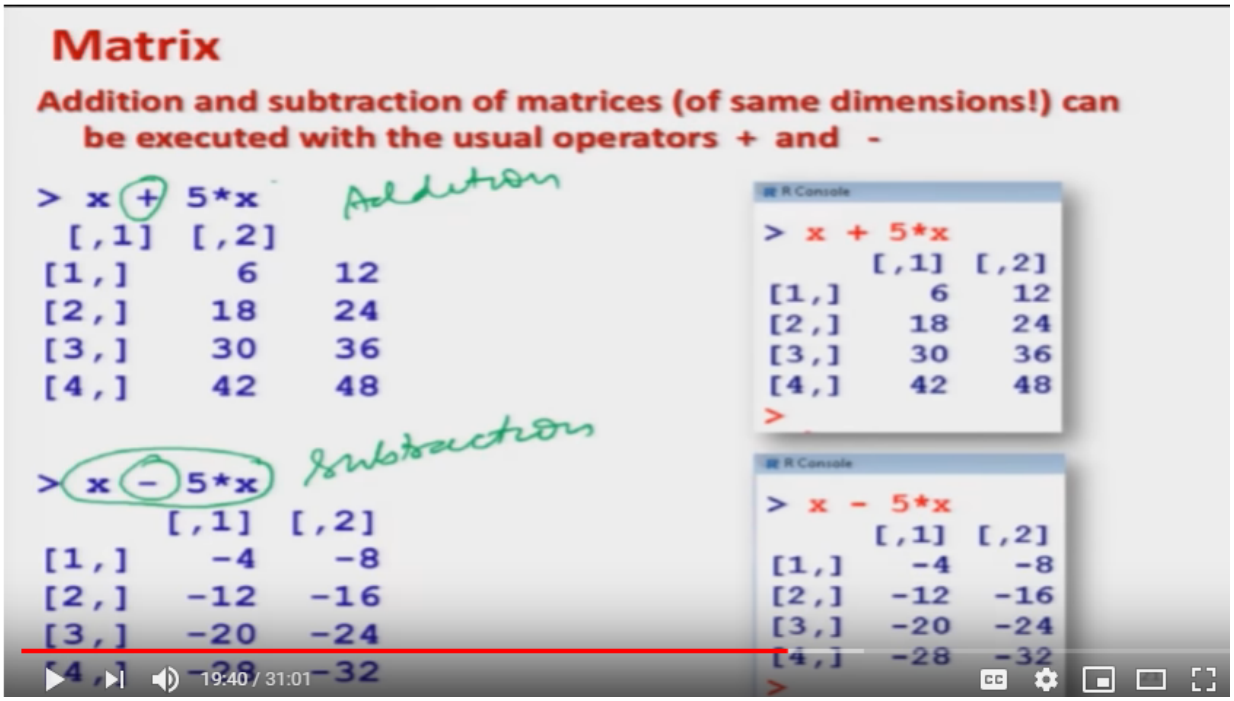

And now after multiplication I would try to address the addition and subtraction Addition and subtraction is quite simpler, simpler in the sense that you have to use the same operator that you had used earlier. For addition you simply have to use the plus operator and for subtraction you have to use the minus operator. But again I would repeat that all the rules are the matrix operation they have to be satisfied here before you try to do any matrix operation. And this is pretty common that once you are trying to handle a complicated structure where you are trying to deal with the various matrices many times the orders of the matrices do not match and this gives you a adder that you have to actually see what is really happening. So, just be careful so, when I am trying to add here two matrices here a and B I will assume that they have got the same order say m cross n and I am trying to subtract here two matrices. And we I will assume that they have got the same order that means the same number of rows and same number of columns. Now I'm trying to consider here the same matrix which I had created earlier and you can see here that this was another matrix which I had created five into X. so, now I have here two matrices here X which is of order 4 by 2 and then I have here another matrix here 5 into X which is of order 4 by 2. So, I can add it together so now I try to add X and 5 X and you will see here that what will really happen that all the corresponding elements of x + 5 X will be added. And similarly in case if I try to do here fraction here then what will happen that the corresponding elements of the two matrices will be subtracted. So, using the plus operator I can do addition and using the minus operator I can do subtraction which is pretty straightforward. Right? So, I can show you here on the R console also. So, now if we take here one more example of the same matrix Y&Z that we have created earlier to have to show you the addition and subtraction operations

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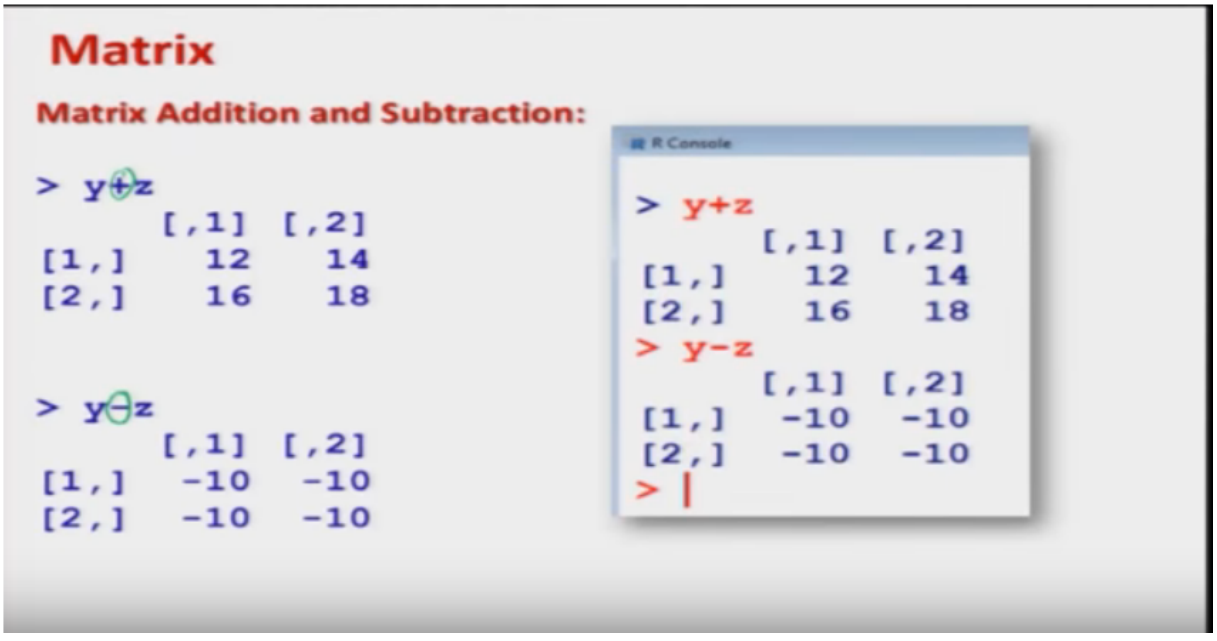

So, if you try to see here earlier I had created these two matrices, Y and here Z of order 2 by 2 the Y was order 2 by 2 Z was order 2 by 2 using the data set 1 2 3 4 and 11 12 13 14. Now in case if I try to make it here addition so you can see here or rather I can show you this and 11 will be added 2 and 12 will be added 3 and 13 will be added and 4 and 14 will be added and same thing will happen to the subtraction

also. Right? So, these are the here the operation if I try to use here in addition operation operator and if I try to use here subtraction operator 2 matrices of the same order have been added and subtracted. Right? So, before I go further let me try to show you it on the R console also so, you can see here. Okay? first let me go through here X and you can see here this was very matrix X and now you want to do it here X plus 5 into X so, this is here something like this and if you want to see here 5 into X is what here so it is like this so, you can see here that X + 5 X are added together. Right? And similarly if you try to see here this is your here X and if you and if your 5 X is like this and now I try to make it here 5 X minus X subtraction. So, you can see here write the corresponding elements have been attracted and if you try to make it, it X minus 5 into X I mean then again all the values with a negative sign will locker. And similarly if you try to recall I had created this Y matrix and set matrix so, I can make it here y plus Z you can see here this is like this I mean the corresponding elements are added and if
I try to do subtraction Y minus Z then the corresponding elements are subtracted. So, you can see here that it is not really a difficult operation. Now I would like to address

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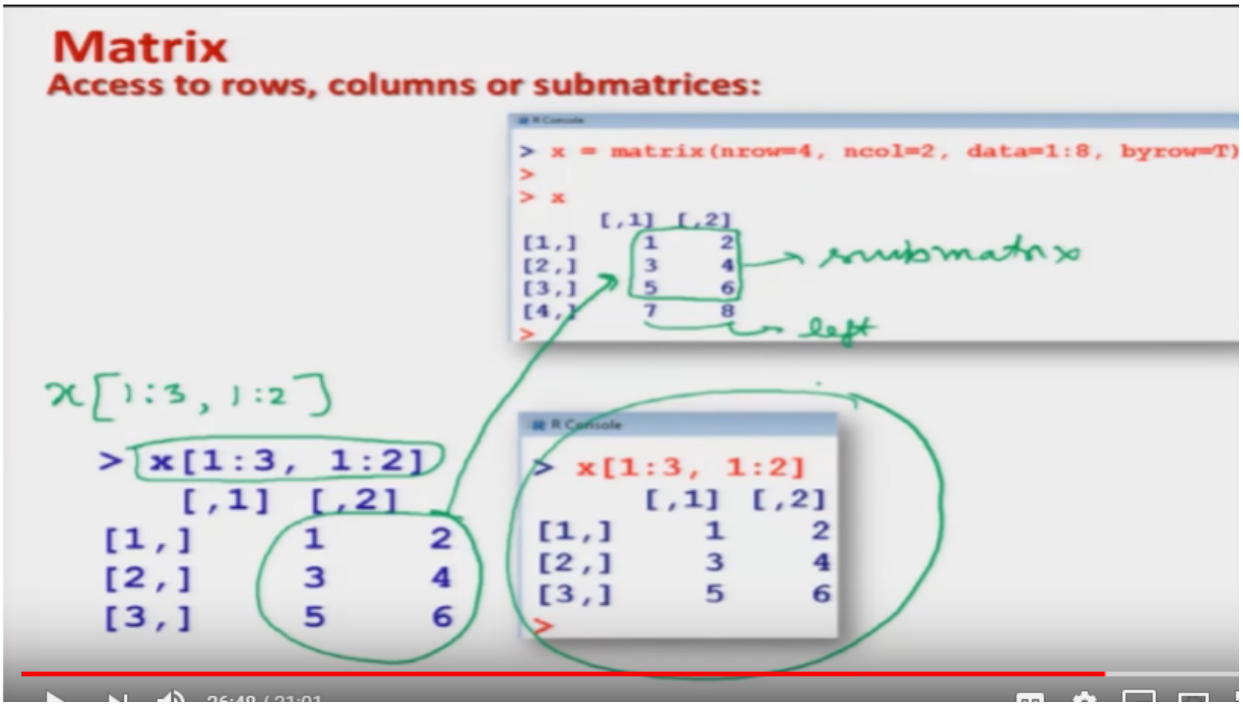

Here another issue that once you are trying to deal with the vectors and matrices then sometimes you need to access a particular part of the matrix that can be a particular role that can be a particular column or that can be a particular sub matrix. Then how to do it? So, I will try to show you here suppose I try to create here a matter which is the same matrix which I have created earlier. And suppose I want to access the third row so, my matrix has been given by C by the name X one, two, three, four, five, six, seven, eight and I want to use here or call that header row. So, in that case I simply have to write down the name of the matrix and then I have to write down the address, address you can see here this is the address of row and here this is the address of column which is actually here blank. So, so as long as you give the address to be the blank this will indicate are that the entire row is needed. So, and it is not difficult to remember because if you try to see this 3 comma blank inside the square brackets this is the same address which is

given over here. so, that is not even difficult to remember sometimes people do get confused that way to put the blank on the row or in the column so, don't worry for these things you simply look in the matrix and try to look into that the row or column that you want to access and simply try to give the same address in the as given in the matrix. And similarly in case if I want to access the second column so, second column here is like this you can see here it consisting of the values 2 4 6 8 so, again the address of the column here is given here it here is a blank sign comma and then 2 inside the square brackets. So, I can write down here the same address over here say her matrix name and then inside the square bracket this is here the row address which is here I left as blank and this is here the column address. And this value will come out to be here 2 4 6 8 yes here you have to be little bit careful that I am trying to call the second column so, ideally this should come like 2 4 6 8 but this doesn't happen in R if you want to call a row or if you want to call a column the outcome will look similar. But whether you are calling a row or a column that can be accessed only by looking at the command whether you have said X inside the bracket blank a space comma 3 or you have said X inside the square bracket 3 comma blank a space. Right? And I will try to show you it on the arc console also but before that I may show you something more that suppose I want to want to recall or access a sub matrix of a matrix sub, matrix of a matrix means a particular section of a matrix suppose I want to find out from the same at least I want to recall this part only and this part has to be left means I don't want to call it so this is the sub matrix which I want to call this is pretty simple always remember one thing Whatever you want to recall just try to give the correct address Right? so I can use here X and now I have to give the address the rows and columns which I want to choose so I'm trying to choose here the rows 1 2 & 3 so, I can give it here 1 colon 3 1 2 3 and what about the columns? I am trying to choose here 2 columns first column its second column. So, I'm trying to use here 1 colon 2 and this is my address and as soon as I try to write down here and enter on the console I will get here the same matrix here. So, this you can compare this is the same matrix and this is the screenshot. So, I will try to show you these things on the R console here.

so, I will try to take it here X this the same matrix that we had considered earlier now suppose I want to recall the second row. So, you can see here I'm simply not typing anything after this after the comma and I will get here the second row 3 & 4 you can see here and similarly if I want to find out share the fourth row this is here 7 & 8 & similarly if I want to find out here, first column then I have to leave it here blank or don't type anything comma 1 and quickest will give me the first column 1 3 5 & 7 but again you can see here that this structure and with the structure they are the same so, you will not be able to look or you will not be able to, to decide whether you have recalled a particular row or a particular column but by looking at these addresses or the structure of these addresses I can always find out whether I have recalled a column or a row. Right? Similarly in case if I want to find out the sub matrix suppose I want to find out a sub matrix consisting of first 3 rows 1 2 3 & 2 columns first and second column then you can see here I am getting here the same thing. And similarly in case if I want to find out here only the first two rows and first two columns then means I can give the row address to be row number 1 and 2 and column number 1 and 2 and you will get let here the same matrix, from here you can see here this is the sub matrix with what you have obtained suppose I want to find out another scum matrix which is consisting of the third row fourth row and first column and I can column. So, I can write down here X inside the square bracket 3:4 and then and the number of columns 1 to 2. And so, you can see here that you are getting the 5 6 7 8 and this is the same matrix here which you have obtained here. Right? So, similarly I have tried my best here to take or consider only those commands ability to relate it to the metric theory which are going to be useful for us but beside those things means most of the matrix operation are possible in our and built-in functions are available for example if you want to find out the inverse of a matrix there is a command

Solve, Solve but this list is very, very long so, I would leave it up to you that whenever you want to use a particular operation, related to metric to metric theory please try to consult a book or the R software help menu and try to see how that matrix operation can be done. And I would like to stop here and I would request that you please try to make more practice so that you get more conversant with these things and from the next lecture we will start with the statistics part. So, you enjoyed the course practice it and I will see you in the next lecture. Till then, Good bye.