Foundations of R Software
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Basics of Calculations
Lecture - 09
Calculations with Data Vector: Addition, Subtraction, Multiplication and Division

Hello friend, welcome to the course Foundations of R Software and you can recall that in the last lecture, we started a discussion on how to do calculations in the R software and we had considered two cases. First was that how can you do the calculations between scalars or among scalars? And, how you can do the calculations between our data vector and a scalar?

And at this moment we are restricting ourselves to addition, multiplication, division and subtraction, four operations and later on, once we understand these basic concepts that how R works, then I will try to take some more type of calculations. So, now, in this lecture, we are going to consider, how R does the calculations when there are data vectors?

For example, if there are two data vectors, then how the additions are done? How multiplication, division, subtraction are done? When we are trying to work in the R software and we are trying to do these type of calculations, so as we have seen that when we took scalar versus a scalar, that it was just like a calculator. But, when we took data vector versus a scalar, then the operation was little bit different. And it was not the usual operation or the way in which all most of the software's work.

Similarly, today when we are going to consider the operations with the data vectors, you will see that the way R works, it is little bit different. And you have to understand the process, that how R behaves? How R follows the instructions?

And I will try to take here a couple of examples and through those examples, I will try to illustrate that, how R works and what are the rules which R follows and that in turn will help you that when you are trying to write your own program and if you want to do a certain type of calculations, then you know, how to write this calculation so that R can understand and do the same thing which you want.

So, let us begin this lecture and I will try to take here some examples, in the beginning, I will try to explain you more. So, that you can understand that, how these things are happening and once you understand the first operation after that understanding the remaining operation will be quite quick, ok.

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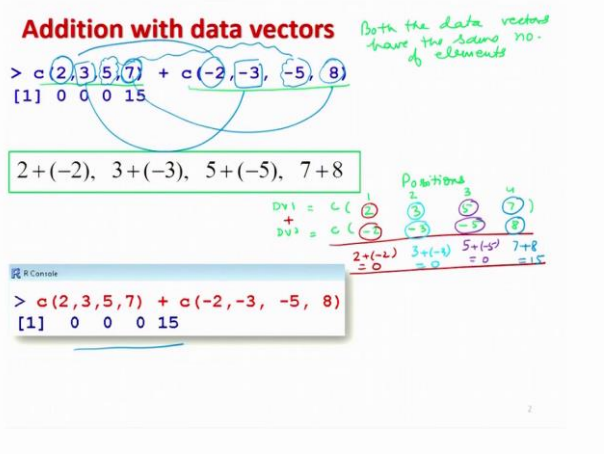

So, now, we are going to consider the operations between data vectors. I am saying between because we are considering here a very simple case. And these cases of two data vectors that can be extended to any number, which I will try to discuss later on. So, now let me try to first take a very simple example in which I have got a data vector, with four values 2, 3, 5 and 7 and the second data vector which also has four values -2, -3, -5 and 8.

And you can see here that, both the data vectors have the same number of element the same number of elements or values. There are four values in the data vector 1 and four values in the data vector 2. So, now if you try to see how this data vector is going to operate? Well, first I try to show you, what is happening? And then you can understand it. So, suppose I try to write down here the data vector 1 and data vector 2. So, now, if you try to see here, these are here the positions: position number 1, position number 2, position number 3 and position number 4.

Now, in the data vector 1, in the position number 1, there is an element 2, you can see here. 2, 3, 5 and 7 and in the data vector here 2, these values are here -2, -3, -5 and here 8, right. So, now, what will happen? You are trying to make here an addition. So, now, what will happen here is the following. That, the value which is at the 1st position in the

data vector 1, that is going to be added to the value at the 1st position in the data vector 2. So, this will become here 2 plus minus 2, that will be here 0.

Next, the control will come to the next value and then the value at the 2nd position in the 1st data vector that will be operated with the 2nd value in the 2nd data vector. So, this will become here 3 plus minus 3 which is equal to here 0. Now, the control will come to the 3rd element and the operation on the 3rd value in the 1st data vector and the 3rd value in the 2nd data vector this is going to be done.

So, this will become here 5 plus minus 5 which is equal to here 0. And finally, this operation will move further. And, it will come to the 4th value in the data vector 1 and the 4th value in the data vector 2. And whatever is the operation that is going to be done 7 + 8. So, this will become here 15. So, what you can observe here, that here the operations are made element wise.

That the 1st element is going to be operated on the 1st element, 2nd element is going to be operated with the 2nd element, 3rd and 4th elements are going to be operated with the 3rd and 4th elements in another data vector respectively. So, what will happen here? This and this -2, they are operated. This -3 and this 3, they are operated. This 5 and this -5, they are going to be operated and finally, the fourth values in the two data vector, they are going to be operated. And you get here the value 0 0 0 and 15.

And now, the same type of operations will happen if you try to replace the addition with respect to or addition in you try to replace addition with subtraction, multiplication, division etc. The operations are going to be element wise.

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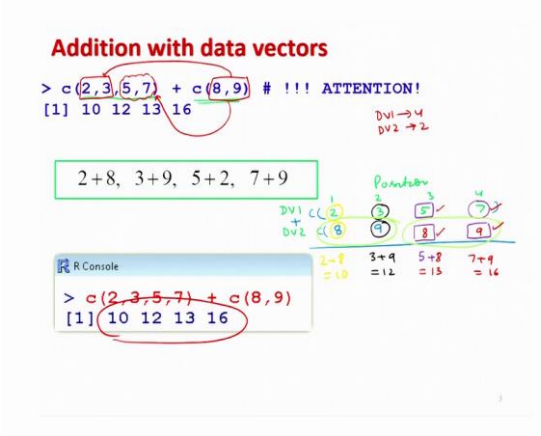

So, now, let me try to take here one more example. So, in this data vector what you can see here I have taken here four elements in the 1st data vector and two elements in the 2nd data vector. So, what will happen here if I try to write down exactly in the same way? So, there are four positions 1, 2, 3 and here 4 and in the data vector 1 there are values here 2, 3, 5 and 7 that you can see here which I have written here, right.

And in the 2nd data vector there are only two values 8 and 9. So, I try to write down here it 8 and 9. Now, and you want to do here addition. So, now the same rule is going to be applied and the same type of operations will happen, but let us try to see what happens? So, as we have discussed that the operations are element wise. So, the 1st element in the data vector 1 will be added with the 1st element in the data vector 2. So, there is no issue so 2 + 8 this will become here 10.

And then the control will move further, and control will try to consider the 2nd value in the 1st data vector and the 2nd value in the 2nd data vector and it will try to add here 3 and 9 which will give the answer 12. Now, the control in the data vector comes to position number 3 here. And it tries to write here 5 and then here plus. But now, when it comes here, this place is blank.

And the, same thing happens when the control come to the 4th value here and then it comes to the 2nd data vector here, this value here is blank. So, now, what R is going to do is the following. It will try to consider the first two values and it will try to copy and paste in the second two values. So, what will happen here is the following, that these two blank places will be replaced by 8 and 9, exactly in the same order in which they are written.

And then, the operations will be done here, that in the value at the 3rd place which is here 5 and the value at the 3rd place in the 2nd data vector which is here 8, they are going to be added and you get here an answer 13. And similarly, the value in the 4th places in data vector 1 and data vector 2, they are going to be added and you get here the value 16 and you get here these four values 10, 12, 13, 16.

So, what you have to understand here, that, when we are trying to work here, that then these two values they are added to the respective positions in the 1st data vector and then after that, there are no values for the second set. So, these values come here again and

they are added to these values. So, there is a sort of repetition. So, the values in the data vector which are lower in number in comparison to other one, they are repeated.

But here what you can see, I have taken an example here, where the number of elements in the 1st and 2nd data vectors, they are the exact multiples. So, data vector 1 has four elements and data vector 2 has two elements. But now, what will happen? Suppose, if a data vector 1 has four elements and data vector 2 has suppose three elements, what will happen? So, let us try to understand this thing also.

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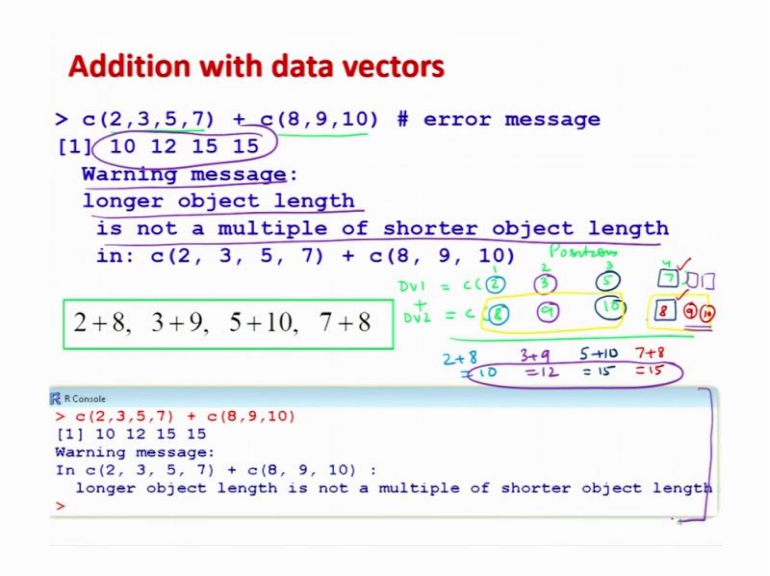

So, now if you try to see here in order to explain you this operation, I am trying to take here one data vector which has four elements 2, 3, 5 and 7 and 2nd data vector which has got value 8, 9 and 10. So, let us try to understand the same operation as we have understood in the other two cases. So, the 1st data vector here is c 2, 3, 5, 7 and then these are located at the positions 1, 2, 3 and 4 and in the 2nd data vector the values are here 8, 9 and 10.

So, now, let us try to do this operation of addition. So, the same rule, whatever we have discussed that is going to be followed. That the control will come to the 1st position in the 1st data vector and 1st position in the 2nd data vector and these two values are going to be added say 2 + 8 which is equal to here 10.

Now, after this, the control will come to the 2nd value in the data vector 1 and the 2nd value in the data vector 2 and this becomes here 3 + 9 which is equal to here 12. After this, following the same rule, the data vector will come to the 3rd value, in the 1st data vector and the 3rd value in the 2nd data vector. This will become here 5 + 10 and it will become here 15.

Now, when the control comes here to the 4th place in the data vector 1 and the 4th place in the data vector 2. So, now, you can see here that this place here is blank; there is no value in this place here. So, now, R is confused. What to do? So, what it does here is the following, that it takes the data vector of the shorter length once again. So, the data vector of the shorter length here is like this 8, 9 and 10. So, this 8, 9 and 10 that is going to be repeated here.

So, now in this place, this is going to be filled with here 8 and then two more values here 9 and 10 they will also come here. So, now, the R will start the operation and then it will try to add here 7 and 8 this will give you the answer 15. Now, after this, R once again become confused. Why confused? That now there are two values in the data vector 2 and there is no value here in the data vector 1. But now, R do not want to move further. So, R stops here. And, it gives the same answer here, 10, 12, 15, 15 you can see here, but it gives you a warning message.

And warning message says that, the longer object length is not a multiple of shorter object length. So, R is trying to inform you that, the length of the two data vectors are not the same; as well as they are not also the exact multiples. So, it is trying to do something, but please try to be watchful and try to see whatever R is doing, is it correct or not? And you can see here the same operation when it is done on the R console also.

So, this is how actually R works and I am sure that now you will understand that how R is doing the things. But before moving further with other operations, I would try to show you that what happens when you are trying to do it in the R console.

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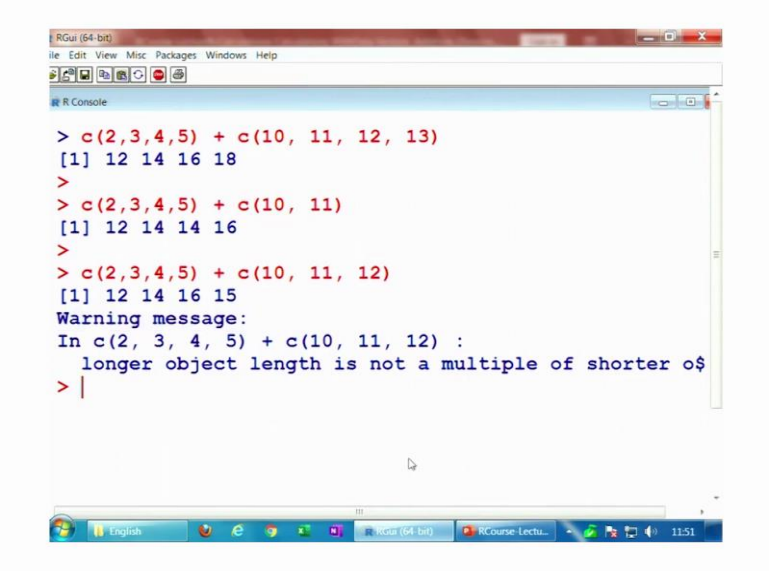

So, if you try to take here two data vectors 2, 3, 4 and here 5 and if you try to add here with say another data vector here say, 10, 11, 12 and 13. So, you can see here means the first value in the data vector 2 is added with the 1st value in the data vector 2 that is 10 and the this value 3 in the data vector 1 is added with the value 11 in the 2nd data vector which are and both are in the second place.

Similarly, the third value in the data vector 1 is 4 and the 3rd value in the data vector 2 is 12. So, 12 and 4 are added and you get here 16 and similarly the 4th value in the data vector 1 and the 4th value in the data vector 2, they are added together and you get here the answer 5 plus 13 as 18. Now, I try to do the same thing, but I try to reduce the number of the elements in the 2nd data vector.

So, now, my 1st data vector has four elements 2, 3, 4, 5 and the 2nd data vector has only two elements 10 and 11. So, now, let us see what happens? So, this 10 and 11, they move from here and they come to 2 and 3 and then the values at the respective places they are added together. So, 2 is added with 10 and 3 is added with 11. So, this becomes here 2 + 10, 12 and 3 +11, 14.

Now, 10 plus 11. Now 10 and 11 they come here, on the 3rd and 4th element in the data vector 1 and then 4 and 10 are added to give you an answer 14. And 5 and 11 are added to give you an answer 16. So, this is how the things happen. Now, I try to do the third

operation, that now I try to keep, four elements in the data vector 1 and only three elements in the data vector 2.

So, now if I try to do it here, what will happen? This 10, 11 and 12 they will move from here and they will come to the first three values or the values in the first three position in the data vector 1 and the respective values are added. So, 2 will be added with 10, 3 will be added with 11 and 4 we will be added with 12 and then after that there is nothing, so the same data vector will be repeated again here and the last value in the data vector 1 which is 5 will be added with 10.

But now there are no more values in the data vector 1, where 11 and 12 can be added. So, 5 plus 10 will become here 15 and after that R will give you a warning message, that the longer object length is not a multiple of the shorter objective length, right. So, this is what is happening. This is the way in which the R software actually works and it does the calculation.

So, I hope, I have explained you in detail, how this addition is happening. Now, the same thing will happen in other operations.

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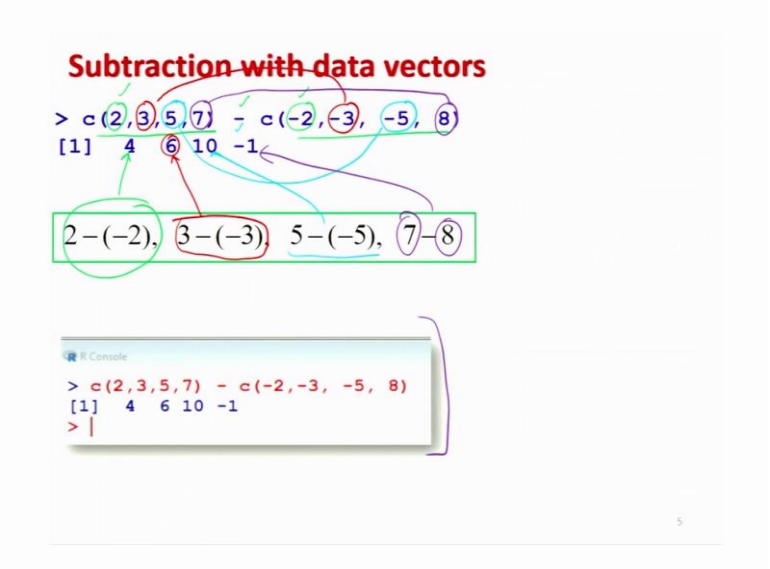

So, now it will not be difficult for you to understand them very easily. So, now, let me try to take here subtraction. So, subtraction you know, that I am taken here taking here two data vectors 2, 3, 5 and 7 in the data vector 1 and -2, -3, -5 and 8 in the data vector 2.

So, now, what will happen? The same operation will happen- elementwise operation. So, the 1st value in the data vector 1 and the 1st value in the data vector 2, they will be operated.

So, now, this will become here 2, this minus and then here -2 which is here like this. And, it will give you an answer here 4. Now, similarly now the control will come to the 2nd value in the data vector 1 and the 2nd value in the data vector 2 and then this and this they are going to be operated like 3 minus inside the parenthesis -3 this value and then it will be become here 6.

Now, once again the same operation is going to be repeated. The 3rd value in the data vector 1 which is here 5 and the 3rd value in the data vector 2 which is -5, they are going to be operated with this minus sign here. So, this and this they will be operated like this 5 minus and within the parenthesis -5 and this will give you answer, the answer as 10.

And finally, whatever is the value in the 4th position in the data vector 1 and the 4th value in the data vector 2, they are going to be operated. So, this 7 and 8 they are going to be operated and. So, this will become here 7 minus 8 and this answer will become here -1 and this is here the operation. So, you can see here exactly the same thing happened here also.

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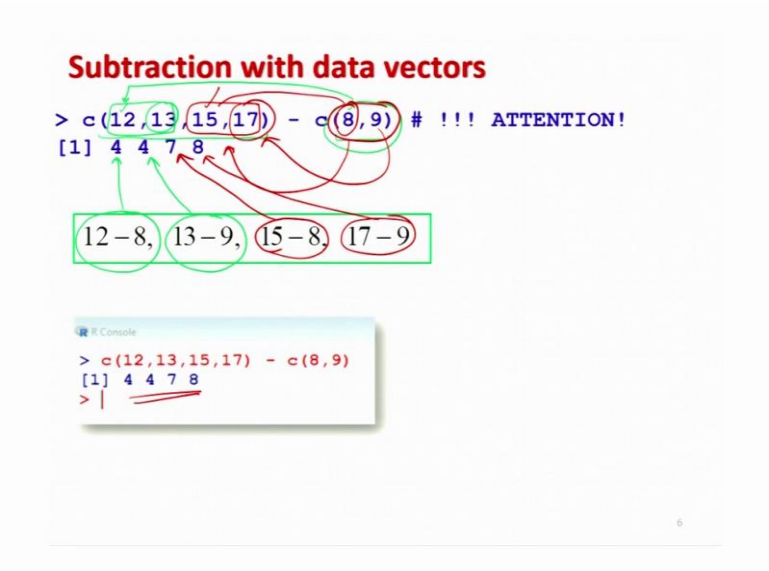

And now, if I try to take a similar example which I took in the case of addition, then I am sure that it is not difficult thing for you to understand that what is happening. So, I am trying to take here four values in the data vector 1 and two values in the data vector 2. So, now, what will happen? That these two values 8 and 9 first they will come here and they will be operated with the first two values in the data vector 1.

So, one value here 12, that is the 1st value in the data vector 1 and another value 8 which is the 1st value in the data vector 2, they will be operated as 12 minus 8 and the answer will come out to be here 4. And then after this the value 9 will be operated with 13. So, the 2nd value in the data vector 1 and the 2nd value in the data vector 2, which are here 13 and 9 they will be subtracted and the answer will come out to be here -4.

Now, after this R does not know what to do. So, what it will try to do? It will try to copy the same data vector which is of shorter length 8 and 9 and it will try to bring it here. And this 8 and 9 will be operated with the remaining two values in the data vector 1. So, it will become here 15 minus 8. This will become here 7 and then 17 minus 9 which will give you here 8.

So, the 3rd value in the data vector 1 will be operated with the so-called 1st value in the data vector 2. And, the 4th value in the data vector 2 which is 17 this will be operated with the 2nd value in the data vector 2. So, this repetition will go on. So, and then you will get here an answer like 4, 4, 7, 8, right. I hope it is not difficult for you to understand.

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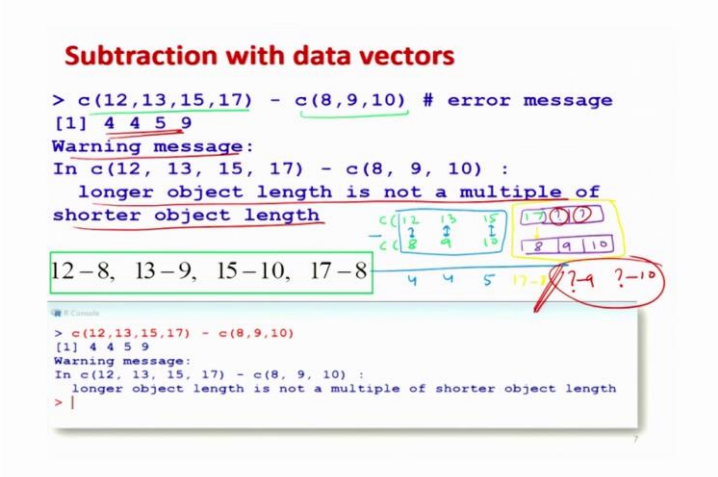

And now, I try to repeat the same type of calculation which I did earlier in the case of addition. That I try to take here four values in the 1st data vector 12, 13, 15 and 17 and then three values in the data vector 2. So, what will happen here? c 12, 13, 15 and here 17 and in the data vector 2 the values are going to be here 8 9 and 10.

So, first of all this block is going to be operated. And your answer will come out to be 12 - 8, using this and this and this 13 - 9 and this and this 15 - 10. So, this will become here 4, 4, 5. Now, after this, when the R software wants to repeat it, the problem is that here we have one value. But in case if it repeats here, so this is here 8, but now after this, there are two more values here 8, 9 and 10. But here in this case these two values are missing.

So, now in the second step, this block is going to be operated, but only the 1st available value which is here 17 - 8 this will be operated. But now, there are no values here and here. So, this will be something like this question mark minus 9 and question mark -10. So, R does not know what to do with this thing. So, it will stop here at this place itself and it will give you a value here 4, 4, 5, 9, but it will also give you here a warning message, that the longer object length is not a multiple of shorter object length.

So, you can recall that in the beginning, when I introduced the R in the very first lecture, I had informed you that R always give you an error message, which are user friendly. That if you try to think about them, try to understand them, you can understand what R is trying to inform you. So, this is how the subtraction is happening in the case of R software.

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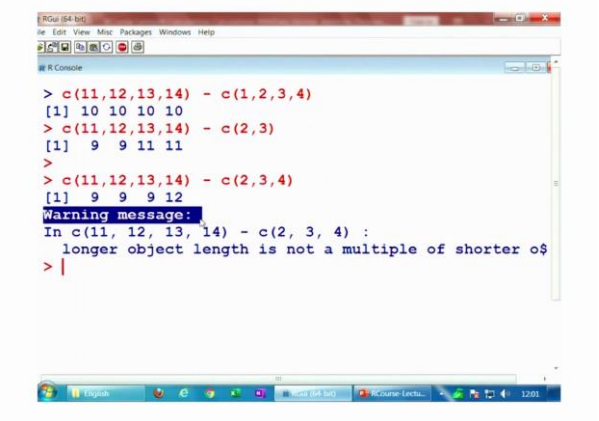

So, now let me try to give you this operation also on the R console. So, suppose if I try to take here some values 11, 12, 13 and 14 and if I try to subtract it with here c 1, 2, 3 and 4, right. So, you can see here that, the 1st value in the data vector 1 will be subtracted by the 1st value in the data vector 2. So, that will become 11 - 1 which is 10. Then the 2nd value in the data vector 1 will be subtracted by the 2nd value in the data vector 2, so this will become 12 -2, 10.

Then the 3rd value in the data vector 1, 13 will be subtracted by the 3rd value in the data vector 2 this is 13 - 3 is 10. And similarly, the 4th value in the data vector 1 will be subtracted by the 4th value in the data vector 2 which is 4, which will once again be 14 - 4 is 10.

So, now you can see here, all the values are here 10, but you know that these four 10s are obtained by different operations, right, ok. Now, I try to take here one more example here and I try to say subtract here only two values say 2 and 3, right. So, you can see here. Now, what is happening? This 2 and 3 they will come over the first two values 11 and 12, then 11 - 2 and 12 -3 both will give you the answer 9 and 9.

Once again, this 2 and 3 will operate over 13 and 14. This will become a 13 - 2 and 14 - 3 which is here 11 and 11. And so you get here this value. And similarly, if you try to take here one data vector with four values 11, 12, 13, 14 and the 2nd data vector with only 2, 3, 4 here, what you see? It is like this. So, this 2, 3 and 4 will be operated over the 1st three values 11, 12 and 13. So, 11 - 2 is 9, 12 - 3 is 9 and 13 - 4 is also 9. So, you get here these three 9s.

And after that, this 14 will be subtracted by 2 which is here 12, but after that there are no values in the data vector 1, from where the remaining two values of the data vector 2 which are 3 and 4 can be subtracted. So, it will stop here, but it will give you here a warning message, ok. So, now, I am sure that you must have understood that, how R works. And now, it will be easier and faster for us to understand the division and multiplication also.

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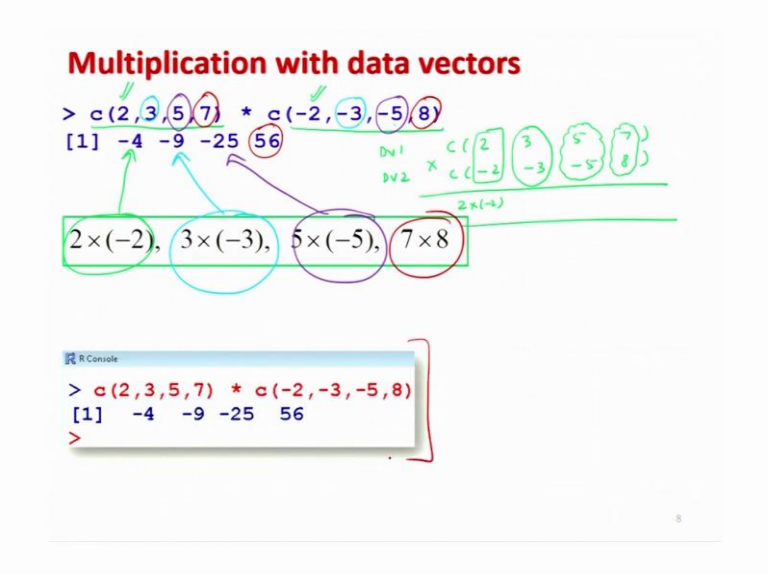

So, now, I try to take the example of multiplication which is quite quick. So, I try to take here a similar example, the two data vectors of the same length. 1st data vector has four values 2, 3, 5 and 7 and 2nd data vector have these values minus 2, minus 3, minus 5 and 8. So, now, the same thing will happen. That if I try to write down here, c 2, 3, 5, 7 from the data vector 1 and from the data vector 2, if I try to write down the values -2, -3, -5 and here 8, then it is multiplication.

So, what will happen? The values at the respective position they will be multiplied together 2 into -2, this will become here like this, -4 and then this value 3 into -3 will happen here. Then, 5 into -5 will happen here, then 7 into 8 will happen here.

So, you can see here, that the 1st position in the data vector 1 is multiplied with the 1st position in the data vector 2. So, this becomes a 2 into -2 which is here -4. Then the 2nd position in the data vector 1 and the 2nd position in the data vector 2 which are 3 and minus 2 respectively. They will be multiplied here and the answer will come out to be here -9.

And after this, the 3rd value in the data vector 1 and the 3rd value in the data vector 2, they will be multiplied and this answer will be 5 into -5 which is here -25. And finally, the 4th value in data vector 1 and the 4th value in data vector 2, they will be multiplied here as 7 and 8 and you will get here an answer 56. And this is the screenshot of the same operation.

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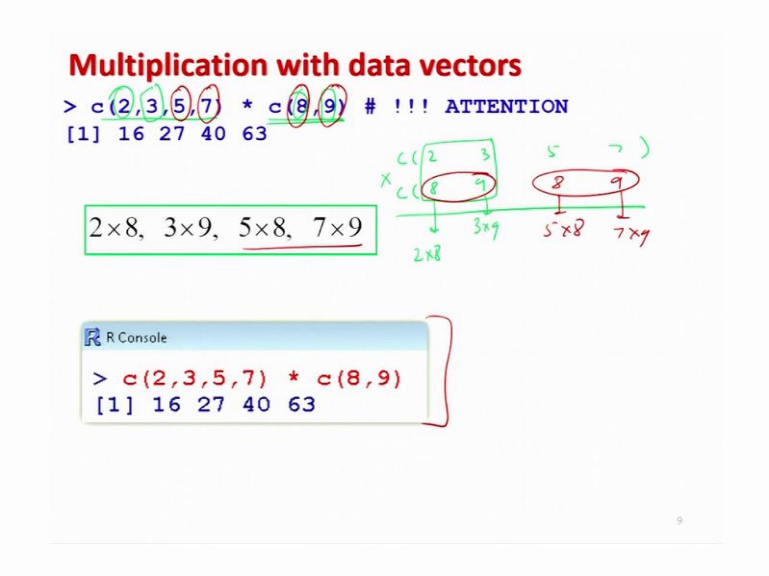

Now, in case if I try to take here a similar example, that if I try to now choose here two data vectors, in which 1st data vector has four elements and the 2nd data vector has two elements which is the exact multiple of the length of the longer data vector. So, in this case, what will happen? Once again, the c 2, 3, 5, 7 will come. Then c 8 and 9 will come. So, in the first short, what will happen?.

That this block is going to be operated and you get here 2 into 8; that means, you try to multiply the 1st positions in the data vector 1 and 2 and the 2nd positions in the data vector 1 and 2. So, you will get here 3 into 9 from here. Now, what will happen? This 8 and 9 they are going to be repeated.

So, this 8 and 9 this will be repeated here and it will become here 8 and 9 and then once again 5 into 8 and 7 into 9 that is the 3rd position in the data vector 1 and the 1st position in the data vector 2, then the 4th position in the data vector 1 and the 2nd position in the data vector 2, they will be multiplied here and you get here a answer like 16, 27, 40 and 63.

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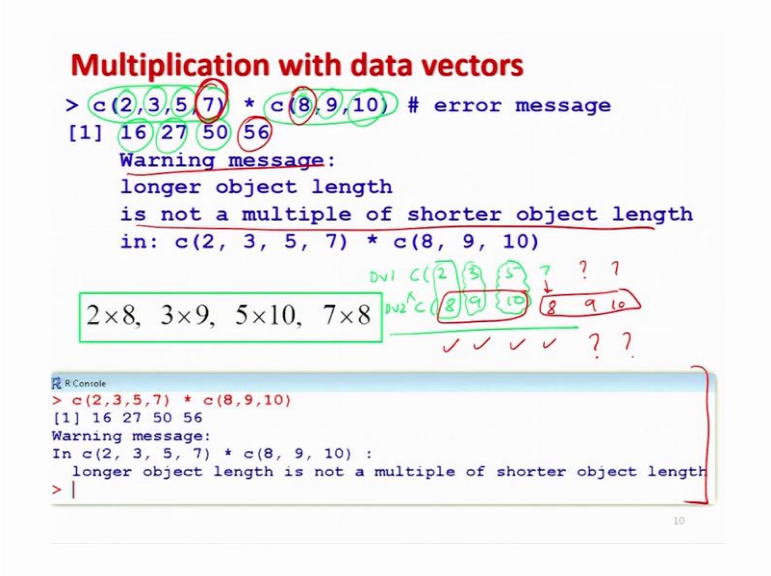

So, you can see here, the same logic, same rule has been applied here also. Now, I try to take a similar example, which I took in the means earlier three cases here, that I try to take here the data vector 1 which has only four elements and the data vector 2 which has only three elements. So, the same thing will happen here once again. So, you will have a 2 3 5 7 in the data vector 1 and data vector 2 will have c 8, 9 and 10.

So, their respective positions are going to be multiplied. So, first this 2 and 8 then 3 and 9 and then 5 and 10 they are going to be multiplied. So, this 1st position in the data vector 1, 1st position in the data vector 2, 2 and 8 will multiply you get here an answer 16. Then the 2nd data, 2nd position in the data vector 1 and data vector 2 they are multiply 3 into 9 which gives you a 27.

And then, the 3rd position in the data vector 1 and 3rd position in the data vector 2 which are 5 and 10, they are multiply and you get here an answer 50. And after this, what happens? That the same data vector, this will be replaced here 8, 9 and 10. So, now, 7 and 8 will be multiplied here like this, 7 will be multiplied by the 1st element 8 and this will give you an answer 56.

But now, what to do here with the remaining two position in the data vector 1, which have to be multiplied by 9 and 10, R does not know. So, it will give you value the first value, second value, third value and fourth value. But here, it will not be able to do anything and it will give you here a warning, that the longer object length is not a

multiple of shorter object length and so this is here, the screenshot of the same operation when you try to do it on the R console, alright.

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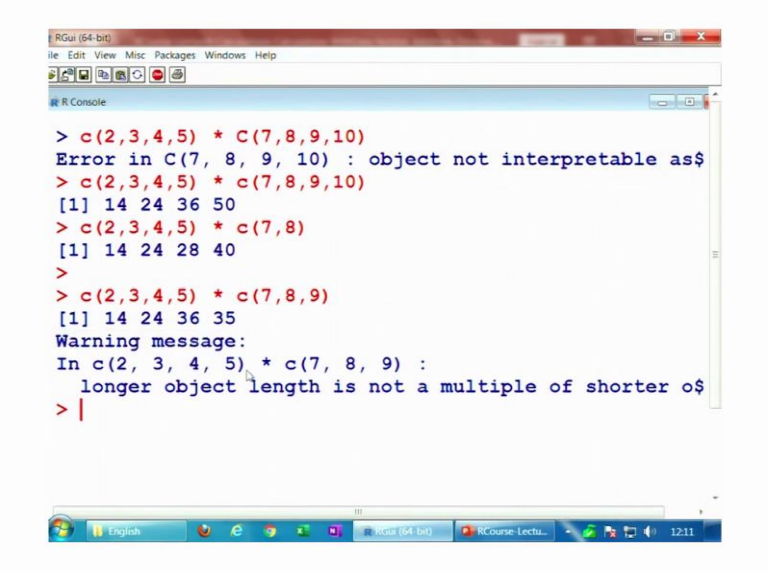

So, let me try to quickly show you these operations on the R software also. So, that you can understand them very easily. So, if I try to take here a data vector c 2, 3, 4, 5 and if I try to multiply it by here means another data 7, 8, 9 and 10. So, you can now see here that. So, you can see here, why it is giving you here error? You know, what mistake you have done or I have done? That, I have taken here capital C, but it has to be here small c, right. So, if you try to see it here, now it will work.

So, this 2 is going to be multiplied with 7, 3 in the 2nd position in the data vector 1 is going to be multiplied with the 2nd positions value in the data vector 2. So, this will be 3 into 8 and then 3rd and 4th value in the data vector 1 which are 4 and 5 they are going to be multiplied with the 3rd and 4rth values in the data vector 2 which are 9 and 10 respectively and you get here the values 36 and 54 into 9 is 36 and 5 into 10 is 50.

Now, in case if I try to make the length of the 2nd data vector to be of only two such that it is the exact multiple of the length of the longer data vector. So, now, you can see here the answer comes out to be like this. Because, what is happening? The 7 and 8 they are coming to the 1st data vector and they try to multiply with the elements in the 1st and 2nd positions and then the remaining two positions at the 3rd and 4th positions they are once again multiplied by 7 and 8. So, you get here 4 into 7 is 28 and 5 into 8 as 40.

Now, in case if I try to make it here the 3rd value as 9. So, that the 2nd data vector has 3 elements and the 1st data vector has four elements. So, if you try to multiply here the 7, 8, 9 this is going to be multiplied with 2, 3 and 4 respectively. And after that, this 5 is going to be applied with the 1st element which is 7. So, you get your answer 2 into 7 is 14, 3 into 8 is 24, 4 into 9 is 36 and then 5 into this 7 this is 35.

But after this, R cannot do anything. So, it is giving you here a warning message that, ok that the longer object length is not a multiple of the shorter objective length. So, this is how the multiplication goes.

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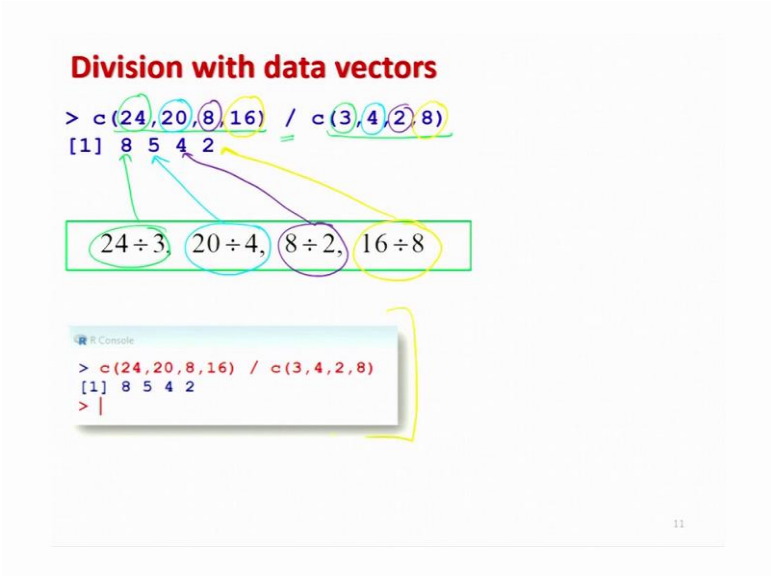

Now, finally, about the division. Now, I am sure that you have understood it all the operations. So, it will not be a difficult thing for you. So, you can see here, that I am trying to take here two data vectors. 1st data vector has four elements 24, 28 and 16 and the 2nd data vector has also four elements 3, 4, 2 and 8.

So, you are trying to divide. So, what will happen? This once again the division will be done with respect to the position; that means, the 1st value which is at the 1st position in the data vector 1 will be divided by the 1st value which is at the 1st position in the data vector 2. So, this will become here 24 divided by 3 this will become here 8.

And then, the value at the 2nd position in the data vector 1 which is 20 value at the 2nd position in the data vector 2 which is here 4, 20 and 4, they will be divided. So, this will

give you here an answer 5. And then, the value at the 3rd position in the data vector 1 which is 8 and the value at the 3rd position in the data vector 2 which is here 8, they are going to be multiplied and you get here a divided by 2 which will give you here answer 4.

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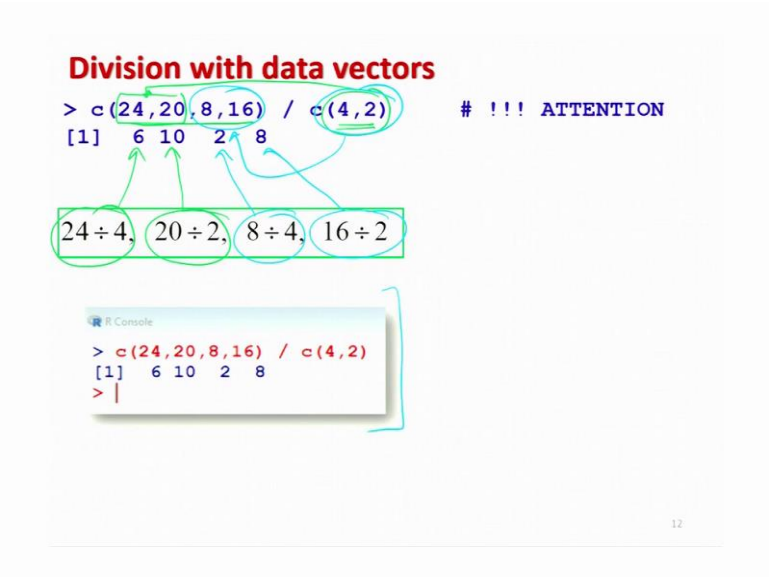

And then finally, this the value at the 4th position in the data vector 1 which is 16 and the 4th value in the data vector 2 which is 8, they are going to be divided. So, this will give you 16 divided by 8 this will give you answer 2. And this is here the screenshot. So, this is a very simple operation.

Now, I try to take here similar examples which I have taken earlier in the case of addition, subtraction and multiplication, that I try to take the 1st data vector of the length four and the 2nd data vector of the length two such that the 2nd data vector is at exact length of the 1st data vector.

So, now, the same operation will happen. That this 4 and 2, they will first come to the 1st two elements of the data vector 1 and they will operate over the 1st two values which are 24 and 20. So, you can see here 24 is divided by 4 and 20 is divided by 2 and you get here an answer 6 and 10.

Now second shot, what will happen in the second step? That once again this 4 and 2 will travel to data vector 1 and they will come here over 8 and 16. So, 8 will be divided by 4

and 16 will be divided by 2 and then you get here an answer 2 and 8 respectively. So, this is the screenshot of the same operation.

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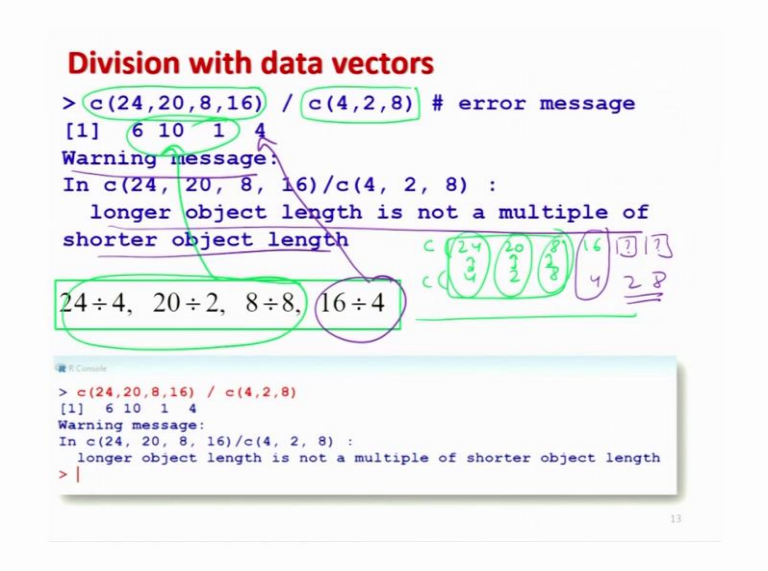

And similarly, if you try to take here the last operation, that where you are trying to take the 1st data vector of the length four, which has four values 24, 28 and 16 and the 2nd data vector which has only three values and which are not the exact multiple of the length of the 1st data vector.

So, once again, the same operation will happen it will like 24, 20, 8, 16 and then it is here 4, 2 and here 8, right. So, now, first of all this block will be operated and the element wise operation will be done. And then, this 24 will be divided by 4, 20 will be divided by 2, 8 will be divided by 8 and then you get here the answer here like this, which is here 6, 10 and 1.

Now, after this, R does not know how to proceed. So, it will try to copy here 4, 2 and 8, the same block over here, but now there are no values in the 1st data vector where the operation can be done. So, this 16 divided by 4 will be operated. And it will give you answer here 4, but then after what to do with the 2 and 8 data vector 1, that is not known to R software. So, it will stop here and it will give you here a warning message, right.

That the same warning message that the longer objective length is not a multiple of the shorter objective length. So, this is how the R software works, when you are trying to division in the case of data vector.

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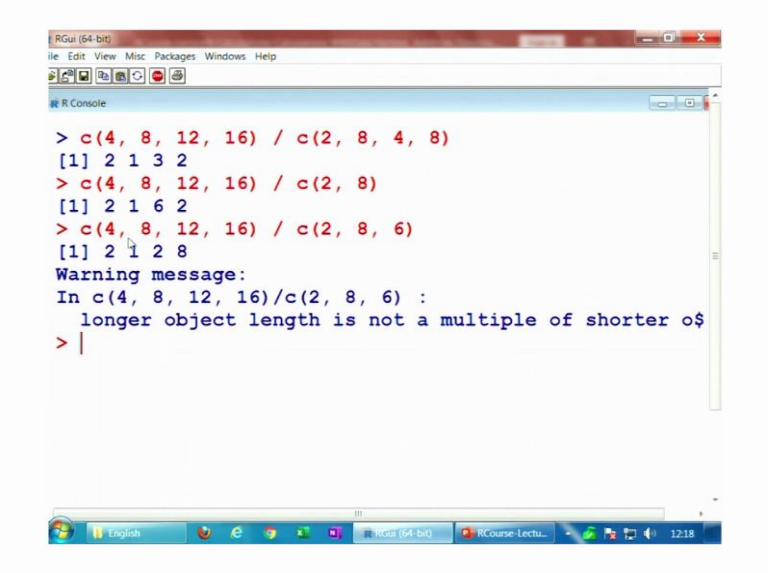

So, let me try to show you these operations on the R console. So that, you can understand them very easily. So, if I try to take here two data vectors. Suppose here, I try to take here 4, 8 then 12 and then here 16 and I try to divide them by here the data vectors here like here 2 and then here 8 and then here 4 and then here 8.

So, if you try to see here, what will happen here? This 2, 8, 4, 8 will be divided by the respective position in the 1st data vector 4, 8, 12 and 16 and you will get here an answer like as 2, 1, 3, 2. 4 divided by 2, 8 divided by 8, 12 divided by 4 and 16 divided by 8. Now, in case if you try to remove two elements that your 2nd data vector is of the exact multiple of the length of the 1st data vector.

So, then the answer will become here 2, 1, 6, 2 because this 2 and 8 is going to be operated over 4 and 8 and then over 12 and 16. And in case if you try to make it here the 2nd data vector of the length say three, something like 2, 8, 6. So, you can see here that 2, 8, 6 that is going to be operated over 4, 8 and 12. But, after this, the 16 will be operated with 2, but then what to do with 8 and 16 that is unknown. So, it will give you here a warning message, right.

So, this is how the operations are conducted in R software when you are trying to deal with data vectors. So, you can see it is not difficult, but there is a different way, there is a different approach. And, I will show you later on in the forthcoming lectures when we try to do some computations that, once you understand that how R is behaving with these numbers, how R is operating with these numbers, then your programming will become much easier.

Very complicated expression can be programmed very easily in R software. And these are some of the reasons why R became so popular. These calculations what are being made here in this specific way, they are trying to help us when we are trying to do the real programming, at least in statistics I know.

So, now, once again you have a good homework today, that you try to take some values yourself, some data vectors and then try to make such operations. Well, just in order to make the lecture simple, I have taken here only two data vectors, but you can take three, four as many as you want. Try to make different combination that, ok out of four. Three data vectors they are of the same length and say four data vector, they are of different length either exact multiple or not.

And then, try to see this different combination, means in the same expression you try to take plus, minus, division, multiplication try to use the BODMAS rule. There are many things which you can understand today after this lecture. So, you try to practice it and I will see you in the next lecture with more operation till then goodbye.