MAT 183 - Elements of Modern Mathematics

TA: Let's look at number 1b and I'm going to solve this not using the Gaussian Elimination method which we covered last time. I'm going to do it using another method that's called the Matrix Equation method so let's set up the matrix equation looking at this question, yes?

Student: Do you have any more of these?

TA: Yes I do, in fact if there are any more people who need any review sheets... You, too? Any other person over here? Let's look at this question now. I hope you'll be able to see on that side. This is number 1b, okay? Now matrix equation is ax is equal to b, so you have to represent this system of linear equations in this format where an a will be the coefficient matrix. By the coefficient matrix as the name suggests it's nothing but the matrix of the coefficient of the variables that are being used over here. There are three variables over here, x, y and z, so the matrix a as expected would be 4, negative 4, 4, 1, negative 2, 2, ah, we have a negative 2, and then we have 2, 1 and 3. Just set it up. x is nothing but matrix representing the variables. Now how many variables are there? x, y and z. Now you set them up from top to bottom so that x, y and z that's your a, x and then we have is equal to b. Now b is equal to nothing but the matrix containing the constant terms which are on the right hand side of the equality sign. Okay? So we have negative 8 and negative 1, and 1. This is known as the Matrix Equation, so if, I mean I would suggest if there is a question on the test which is like solve this particular system of linear equations and it does not say specifically that you have to use the Gaussian Elimination method, then you can, you should, in fact I would encourage you to use this method because this is very systematic. You just have to plug in the numbers into the calculator and the calculator does it for you. Okay? So, since ax is equal to b, it means that when you solve for x, it becomes x is equal to a inverse b. Okay? x is equal to a inverse b. Now let's look at the calculator and what we do. Now everything that I do on the calculator will be reflected over here so just follow closely. If you have any questions, just ask me any time. Okay? So first you have to do second and matrix. This is TI-83 Plus and second and matrix and you'll reach this. Thereafter all you have to do is edit the matrix a. So, scroll to the right and we have edit. Choose the matrix that you want to use for editing, for putting in the matrix a. So choose, say a. The first and foremost thing that you have, have to understand is what are the dimensions of this matrix. Can anybody tell me what are the dimensions of a? Yes?

Student: Two by 4.

TA: Sorry?

Student: Oh, it's columns, right?

TA: It's number of rows by number of columns.

Student: Three by 3.

TA: Three by 3. Perfect. Good. So, we have 3, enter, 3. So, we get a 3 by 3 matrix and then we, you can enter it. So, for setting up any matrix into the calculator you need to know the dimensions. Just remember that, okay? So just plug in the numbers and we have 4, negative 4, 4. Just keep entering the number and go across and then down. You go across and then down. So we have 1, negative 2, negative 2, 2, 1, 3. And that's all. So you are all set for the matrix a. Okay? Next you have to do is second and quit, so that you reach this empty screen. Again, second and matrix and again edit. Now you want to edit the matrix b. Okay, now you need to edit the matrix b. Now, matrix b has what dimensions? Can anybody tell me, please? Yes?

Student: Three by 1.

TA: Sorry?

Student: Three by 1.

TA: Yes. So, just put in 3 by 1 and just put in the numbers as they are. So, that's negative 8, negative 1, and 1. Then again, second and quit. Now, how do you solve it? As I said, x is equal to a inverse b, so all you have to do is into the calculator you just have to find the name of the matrices, the name of the matrix where you entered the matrix a, name of the matrix where you entered the matrix b. That's all that you need to remember. So, it's second and matrix. The names are over here, so just choose a. Now there is a button over here which says x inverse. Just click on that. Multiplied by the matrix b. So, again, second and matrix, choose the name b, scroll down, choose the name b, and you get a inverse b. Once you enter you get the answer to this question. Which is 1, 2, negative 1. Are they any questions? I mean, anybody who did not get this answer? Or anybody who is having any doubts? Yes?

Student: On the test, can we just leave it like that or show all of that?

TA: You need to write all that I wrote over here. You need to write that you're using the Matrix Equation method. I mean, ax is equal to b which implies that x is equal to a inverse b. You set it up in this manner, write what you're using on the calculator. Okay?

Write all the steps because sometimes you know the calculator might give, might give you a wrong answer, but if you have written all the right steps and it is something related to some setting in the calculator, you won't be penalized for that. Or maximum that you'll be penalized is a negative 1 which won't make that much of a different. Ninety, ninety percent credit will be given.

Student: Okay.

TA: So write all the steps. Yes?

Student: One time you said that, um, you said that in the thing when you, if you give a specific number, you go to the RREF. What is it, if you get a 0?

TA: I'll explain that situation. So if this is clear then I'll come to that. Okay? I'll just come back in a minute. Yeah?

Student: I have a question about showing work. Can you do all the problems in the calculator or does it have to be like...

TA: Okay, again, if the question on the test says that, use the Gaussian Elimination method to solve the system of linear equations, you have to row, Elementary Row Operations method. Okay? But, personally speaking, you will not be given a very complicated question. It might be a 2 by 2 matrix or just a, um, you know, two, um, systems of linear equations having two variables, okay? Or, the second question that you could encounter would be pivoting. Okay? What pivoting means is, if you have any matrix. For example, 1, 2, 3, 4, 5, 6, 7, 8, 9. This is hypothetically speaking any matrix, and if the circle around any element and they say, pivot this matrix around the circled element, you have to use the Gaussian Elimination method, you have to use the Elementary Row Operations, but all you have to do is reduce this somehow to the format that you get 1 over here, 0 over here, 0 over here, and the remaining numbers will automatically change. It doesn't matter as long as you get the first column as 1, 0, 0. So, 1 in the place of the pivot element, 0 in the places in the same column. Okay? So these are they type of questions that you can expect from Gaussian Elimination method. Now this, what I just did is the Matrix Equation method. Okay? For solving a system of linear equations. Now we got the answer as 1, 2, and negative 1, so what we can say is x is equal to 1, 2, negative 1, which implies that x, y, z is equal to 1, 2, negative 1. Which implies that x is equal to 1, y is equal to 2, and z is equal to negative 1 and that's your final answer. And you're done. Okay? So, the first thing that you should do, you must do, is if Gaussian Elimination keyword is not given to you, use this method. If the inverse exists then you will definitely get an answer immediately and you'll be done and you can

move on. Okay? Now we'll discuss something that's slightly, I mean, complicated, but just concentrate and it won't be any problem. How does it go up? Yeah, so I mean, given a situation wherein you find that you have plugged in all the right numbers, but sometimes you will end up with an error. Okay? If you encounter this error, okay, on the calculator, than it's, I mean unless you've plugged in the right numbers and if the inverse does not exist, you end up with an error. It not any error from your calculator, it's not, you know, like your calculator's not working, it's something to do with the system of linear equations does not have an exact solution. It either has no solution or it has infinitely many solutions. Now, what that means is let's look at a question over here with no solutions. Okay? So let's look at, it's already saying no solution on the question, okay? So we have question number 1 part d. Do you have a question? This side? Okay. So let's set it up now. We already know in this case, I mean the answer will not be given to you on the test, so first you will actually do all this and you'll find, and you'll end up with an error, so then you have to revert back to sort of Gaussian Elimination method. So then, I mean, what you have over here, is, we can just straight away set it up so 1, negative 1, 3. Remember the matrix format that we did last time? When you want to reduce the system of linear equations to a matrix format, so this is. So this is the matrix format of question number 1, part e on your review sheets. So we have negative 2, 3, negative 11, and then we have negative 4, 1, negative 2, 8, 6. So just set it up. So you've already done all this homework and you ended up with an error, so you set this equation, this, um, matrix up and then what you can do is edit this matrix into your calculator the way we did it over here. So, can anyone from this side in the back tell me what the dimensions of this matrix are? Yes?

Student: Three?

TA: Three by? It's number of rows by number of columns. How many columns are there?

Student: Four.

TA: Yes, so the dimensions are?

Student: Three by 4..

TA: Perfect. Thanks. Sorry?

Student: Why is it different now?

TA: It was 3 by 3 in this case, but now we have one, two, three, four columns and one,

two, three rows, so it's number of rows by number of columns. Okay? So this, this you need for editing into the calculator, right? So, so let's just, um, yes?

Student: What was this over there again?

TA: Okay, that's the Matrix Equation method, okay? Remember last time we did the Gaussian Elimination method. This is one method and it's over, it's done. In case you feel you end up with an error with that method, then you revert back to this method. Okay? It's a sequence of operations that I'm talking about. If there's a complicated problem, okay, it, only if somebody wants to really, really test you or something like that, then they'll give you a complicated problem, you'll try this, end up with an error, then revert back to the matrix format and then you use something that I'm going to talk about right now. Okay? So this is your matrix, so you, all you're going to do is edit your matrix into the, so second and matrix. And let's just edit this matrix into, say, into, say, c. I mean you can just use your calculator. Do you want me to actually pull this down? If you have your, um, you have your calculators just put it into your matrices, so let's see c. So this is a 3 by 4 matrix and then you just put in all these numbers 1, negative 1, 3, 3, negative 2, 3, negative 11, negative 4, 1, negative 2, and then we have 8 and 6. Okay, now all you have to do is, once you have edited this matrix in, say c. Okay? Let's suppose you edited it in matrix c. Okay? It's a 3 by 4 matrix which you've put it into your calculator. Let's assume that. Now, all you have to do is again, second and matrix, and then you have to go to the middle menu, which is math. And then you just scroll down, down, down, down, down until you receive, until you see RREF, okay? RREF. Okay? Just press enter after that. So once you have quit, you do this. So, even if, if I do over here, maybe you would be able to see it. Second and quit. And you have second and matrix and we have math in the middle. You can still see it. And if you scroll down, down, down, down you see RREF and you press enter, okay? And this takes a parameter which is the name of the matrix wherein you plugged in all these numbers. That is the matrix c, in our case. Okay? Or whichever you chose, okay? So just remember wherein, wherever you put it in. So the name of the matrix is c. Once you say enter, it gives you a matrix. Now it gives you a matrix which is like this. So it says, 1, 0, negative 2, 0, and we have, I believe, 0, 1, negative 5, 0, 1, 0, 0, 0. How do you interpret the answer after you receive such a matrix? Guys do you remember like we did Gaussian Elimination method and we used all those Elementary Row Operations and then we had to reduce this and we somehow could have reduced using nine Elementary Row Operations to this format, but instead of that, with the calculator it becomes very easy. All you have to RREF and the name of the matrix. So that was c and you end up with this matrix. Now you have to just interpret the results now. Now this implies you have to again, now you know how to convert the system of linear equations to the matrix format. Now I'm going to do is, what I'm going to do is, reduce this back into the system of linear equations.

Okay? So, how do you do that? One, 0, negative 2, 0, 1, negative 5, 0, 0, 0. How many variables were there? Three, x, y, z, is equal to the constants which are 0, 0, 1. Okay? So, what we are doing is the reverse thing. Initially we converted the system of linear equations into the matrix format. Now we have reduced it to this form and now we are again converting it into that form so that so that we can interpret the results. How do you do that? By multiplying. Basic multiplication by hand is 1 times x plus 0 times y plus negative 2 times z. And it goes on and on, so I'll just write all the steps. This is 1 times x, that's 0 times y plus, so we have negative 2 times z is equal to 0. Zero times x plus 1 times y minus 5z is equal to, again, 0. This 0, 0 is nothing but these two 0s over here. And then you have 0 times x plus 0 times y plus 0 times z is equal to zero. If you look at it very carefully, just, just look at the last row. It's 0 times x plus 0 times y plus 0 times z is equal to 0, so that's, it's not equal to 0, sorry. Equal to 1, as it is, okay? So this implies 0 is equal to 1. Is it ever possible to have 0 equal to 1?

Student: No.

TA: Mathematically it's not. So you have arrived at a situation where 0 equals 1. This implies when you reach such a conclusion. This implies there's no solution to the system of linear equations and we're done. That's all that you have to do. Okay?