

*Rory and Qian and pseudonyms for the two students in the focus group. We missed recording the first few minutes, so it picks up mid-thought. We've learned that Rory is now probably a CS major, after switching out of Actuarial math.*

Rory: ...um I also took math 424 and I really just didn't enjoy 424 as much as I really should have um and especially i'm considering switching just because. It is a core class to the actuarial major and I will be, you know, applying a lot of that content to my future career and I realized if I don't really enjoy it as much I may want to consider doing something that I do enjoy a bit more.

Nina: Okay, so, would you be switching to something else and math or some other totally different major?

Rory: i'm probably a totally different major. Right now i'm looking at either computer science, or even cognitive science, with a minor in computer science, but i'm still kind of exploring options

Nina: okay. And Qian What about you.

Qian: um so I have two majors: first is mathematical science in the one called probabilistic methods and another one is biology.

Qian: yeah two totally different.

Qian: majors with no.

Nina: So is it correct, then that both of you are taking math 217 in the fall to satisfy the requirements for your major?

Qian and Rory: Yes, yes.

Nina: I'm going to start with you, Rory, are you taking any math courses this semester?

Rory: And not taking a direct math course, I am in stats 426 but i'm not any math courses.

Nina: Okay Qian What about you?

Qian: i'm taking 316, 451, and 547.

Nina: What is 547?

Qian: mathematics of data.

Nina: Ah, OK.

Qian: So, like a like a graduate course, but like, undergraduates can take that.

Nina: Okay that's just a course number I don't know off the top of my head so that's... Okay, when then for you um do you feel like 217 prepared you for these courses? like, do you see ways like that it did or did not prepare you for these courses?

Qian: um yeah I think yeah it did prepare me for like for 316 and then 423. Obviously, because I think i'm most of my like most of the students taking these two courses like they have taken 217 before, and then I think I assume that they got a pretty good grade in 217 so they continue to like major in math so um. So I think I consider them as like good teachers for me. And then, and, Because the materials in 217, very often abstract right. A lot of proof and this prepare me a lot for 451 because yeah that intense course.

Nina: OK, so the proof-writing in 217, It felt like it prepared you for the

Qian: yeah.

### **[[about taking linear algebra before, or not]]**

Nina: Okay had either Have you taken any linear algebra before 217?

Qian: Yes, I did.

Nina: You have what kind of linear like where did you take it, what kind of class was it that you took before?

Qian: I transfer here, so I took it before at Boston university. Okay, and then it was, I think it was like 214. Or maybe easier, I don't know. But um, I think the course materials covered in that course is like Only the first, like,  $\frac{1}{3}$ , like before the first midterm 1 of 217, so while 217 is really, like, intense, the other course I took how has no, like, proof-writing, or any abstract.

Dick: So it was a traditional computational course which is mostly what 214 is, yes.

Qian: yeah yeah.

Nina: Rory, What about you have you taken any, or seen any linear algebra and any courses before 217?

Rory: I had not.

Nina: okay. um what did, like, so Rory for you taking 217, did it, did that feel like a disadvantage? did it feel like many of our students had taken linear algebra? or what was your perception of that while you were taking the class?

Rory: um in a way it did, i mean just because, you know, it is one of the math courses that doesn't transfer easily to UM. And so it was a bit challenging to be learning how to, you know, write these really in depth proofs as well, but also just in addition to that, just learning the content, um, so learning both of those was a lot at once. I had taken, like, math 425, which was a little bit proof-based, but not as heavy as 217, and so I did feel slightly at a disadvantage, just because I was learning so much more than I felt like my peers were, um, a little bit.

Dick: You take 201, at the same time?

Rory: I did not, I didn't have time because it felt during a different time that I had a different course.

Nina: Okay, Qian what about you did you take Math 201, at the same time?

Qian: No, no. yeah I think same reason.

### **[[how each student worked on classwork outside of class]]**

Nina: Okay. i'm i'm curious for you, what did a week of out of class workload look like? so looking back on last semester, not a not a week, where there was a midterm like a regular week in the course. What did your time out of class look like like? how many days a week were you working on it? were you working on it with peers? like how much time, are you spending on the written homework or the Web homework? Like take a moment to think about it, like, write it write it down kind of like what was your weekly a typical weekly schedule, as it related to 217. So i'll give you a moment to kind of reflect, because I know we're well into the next semester, so you might need to think back a little bit.... And if either of you whenever you feel like you've got like a good summary of that you can you can just type in.

Rory: um I can start. so normally I would... I guess, i'll start kind of like on Fridays, just because the written homework was due Thursday nights for the main portion of the Semester. So Fridays and into the weekend, so Saturdays and Sundays, I would spend mostly just going through the problems that I can do myself, um. So that included both the Web homework and the written homework, I went through I would normally just read through the in homework. And do the book problems I could do on myself and then Monday I would go to the math lab outside of class and get help on the web homework normally because that was due before the written homework and so i'd go to the math lab on Mondays to get help with the Web homework. And then, once I finished that um so either on Mondays are also starting on Tuesdays possibly I would go to the math lab Tuesday,

Wednesday, Thursday to get assistance on the problems that I needed for the written homework. And so, normally I would do that, right after my classes ended so depending on the day that was you know right at 10 once my linear algebra classes over or around one one my other classes were done. And I would spend time there until around four when the tutors were done with their shifts. And then at that point, I would go back and if I still had a little bit more to do for that day I would work kind of on my own, but a lot of it was spent at the math lab working with the tutors, just to have... like, I would still sit at the mathlab and do it on my own, but it was nice to just, you know, if I did come across something I didn't know how to do, to be able to just walk over to a different table and ask them questions about it.

Nina: So why did you utilize the math lab rather than, say, like the 217 office hours?

Rory: So my instructors, I honestly was intimidated to go to other instructors' office hours, just because I do really appreciate that connection with my instructor. And her office hours were Thursdays and Fridays, and the Thursday one fell when I had a different class. And Fridays at that point we were done with her and homework and so it wasn't super beneficial. And also just it is really helpful to have a student that had taken that really recently, um, whether it be, you know, just last year, or a couple years ago, and so it was really helpful for me with that just because I do at times get a little intimidated by some instructors and like, you never know how many people will be there, but the mathlab on it was nice to just like be able to see oh there's only one other students talking with that tutor right now.

Nina: And, did you ever utilize... I know there's, these, like half hour appointments to can make with people who will, like, help you, with your proof-writing did you ever use any of those appointments?

Rory: I did, well, I tried to. It was supposed to be a Zoom one, but they never emailed me the zoom. um, but it ended up working out. Like I had the homework assignment done before, I was just going to have them read through it, and I ended up doing well on the assignment anyways. It was just to kind of, you know, make sure it's going in the right direction. So I didn't do any harm at all, I think that there might have just been a slight miscommunication or something. Okay, so I was fine with it.

Nina: Sorry, that that happened, no that's....

Rory: ...No it's okay.

Nina: um so Rory what would you say, like, you described a lot of time in the math lab with how many hours would you estimate total and that's typical week?

Rory: In a typical week, honestly, probably close to 10. Depending on the day, but it was probably close to 10 at least just because some days it would be longer just because,

like if I did have a question, I would have to go over to a tutor and then wait a little bit until they were available and done with another student um. And so, like especially towards the end of the week, when 217 assignments were due, and assignments for other classes were due, the demand was super high. So it was a little bit longer just because i'd be sitting there waiting a little bit, because I don't want to forget my question. But, um, it was definitely around 10.

Dick: And that's just to math lab then? And then on your own how many hours?

Rory: um I honestly got a lot of my work done in the mathlab and it was because I would like once I get my question answered I would work through the proof, while they were answering a different question from a different student and then I would have like go through and explain my processing on what I did and they would either help me, if I had gone in the wrong direction, or they would say like yeah that's good um, and so I really think that a lot of my work was done in the mathlab.

Nina: Okay, Qian, i'm going to ask you all these same questions in a second. I have one more follow up question for Rory. Did you work regularly at all with other 217 students, like, either from your class? or did you were some folks just always there in the math lab that you kind of got used to working with? or are you mostly kind of on your own?

Rory: um I would occasionally ask, I had a couple friends that were in different sections, and so I occasionally ask them for clarification. But, quite honestly, a lot of it was done on my own and with the tutors. I did have a few tutors that, um, really enjoyed 217. Like, they even said that to me, like, "oh my gosh I love 217", and so I would normally work with them when they were on staff during that day. But a lot of it, honestly, was done by myself, rather than with other students.

Nina: Okay, Qian I want to ask you: what did your typical week look like, out of class, for 217?

Qian: Okay um, so I had a learning style, like, totally different from Rory. So typically I don't study during like, during, like, from Friday after the assignment is due, and, like, to the weekend. And I, like, I start studying on Monday. On Monday I think i usually finish all the web homework for the week and I use, like, I don't know, maybe, like, two to four hours? And then, it was longer till the end of the semester because they're all calculations, I guess. And then I start my, like, written homework, like, typically on Tuesday. I think I, like, I look through all the questions on Tuesday and make a draft, and then I, like, I typically slept over them and then I... Um, on Wednesday, I like write, like most of the, like, the process and the proofs. But not, like, completely complete. And then on Thursday, like, I finished them, I think, and that is, due on Thursday. Yeah.

Nina: And so, did you work by yourself, or with others?

Qian: Monday, Tuesday, by myself and Wednesday I work with a friend from my own section, from 217. Like, I think, maybe two three hours after class and then Thursday by myself.

Nina: Okay, and so your friend for him 217 did you know each other, ahead of time or how did you, like, make friends with someone to work with?

Qian: Oh, we just met on, like, on that class because I .. we are all, like, Chinese and then we, like, communicate easily I guess? yeah.

Nina: Okay, so it was another Chinese student in the class with you and you kind of clicked and started working together?

Qian: yeah.

Nina: great.

Dick: hours, did you think you spent on that written homework?

Qian: Wait wait can you repeat that?

Dick: How many total hours on that, sort of Tuesday, Wednesday, Thursday, when you were working on the written homework?

Qian: I think... Maybe... I don't know if that was, like, easy, maybe, four, if that was hard, maybe eight.

Dick: Ok.

### **[[what helped them succeed in Math 217, in and out of class]]**

Nina: Um, okay i'm kind of changing the order of my questions here a little bit um. One thing I want to know is what was most helpful to your learning in 217? and this could be a particular resource, it could be a particular person you don't have to tell me their name but, like their role, it could be something you did personally to learn the material. Like, what was, what was most helpful to your learning? um i'll give you a moment to think about that... i've got a kid in the background here to tell me something but OK let's go ahead in here Okay, Qian do you want to start us off this time?

Qian: yeah so, first I want to say symbolab [laugh] Because, like do you know, like...

[background noise]

Nina: Okay, great sorry okay sorry Qian can you say that again?

Qian: You know symbolab, like, is a calculator. Like, software online. I can calculate the, like, the like, matrix multiplications or anything like myself, but it takes, like, too long, I think. So sometimes I did use, like, online calculator. But like aside from that, I think peers are like..., she is my, like, I think she was my hero, because she, like, took taught me like, something like not *all* of them, because she is like she is not *that* good, but like she gave me, like, many mental support, I guess, because I know something, someone, like, we are on the same page and we are like struggling, like, we are like having the same feeling after exams, I guess, so yeah mental support yeah.

Nina: What about you Rory?

Rory: um my instructor honestly was probably the most helpful for my learning um do you want me to mention her name or no?

Nina: it's Okay, no I don't need you to. But i'd love to know more, like, what did she do?

Rory: um she I had reached out to her a couple weeks before the midterm You know, as I started, because I know I was on this was a very challenging course for me, and so I knew that, you know, maybe what I was doing before the midterm, like, I just asked her for advice on preparing for the midterm and what she thought, you know, would be best to review the material and she offered me advice on that, but then also just offered to meet up with me if I needed for a little bit of extra assistance. And then kind of, um, in class she would make it a point to ask everyone, you know, as we're going through proofs together in class, she would ask, you know, everyone certain questions as she's going through a proof for something, which is really helpful. And I really noticed that, because I was a bit more introverted in class, that after I explained that I was a bit strugg... struggling a little bit, she made it a point to ask me directly questions. Just to make sure that I was still keeping track of the proofs while she was going through them. And so, she would ask, I can think of something specifically right now, but she would ask, like, what something meant. Or I guess along those lines, um... The best example I can give right now, sorry, but she would make sure that I was involved, while she was going through the proofs which is really helpful. And then also just before the second midterm she asked me if I wanted to meet up again just to go through some practice problems together, and so, for example, I like went through a practice exam before and walked through the solutions to that with her, which is really helpful and so she really, um, I think that all the students in our class can attest, is that she really just wanted to make sure we were learning and make sure that we were doing okay, and she was really concerned about that as well made that very clear to us, which is really helpful and beneficial.

Nina: that's great Rory. Um, Qian what about your instructor? In class was there anything that your instructor did, particularly in class, that you found helpful?

Qian: Yes, um I love my instructor she, um Like , um ... sometimes in the group, you know, Someone got, like, left behind and then like sometimes it's me, and I say nothing and just hear other people talking and then, like, sometimes they are like three or four questions ahead of me, and then, when my instructor came she would like, like ask me, like, how would I think on the particular question. If I am not like that far, she would ask other students to, like, stop and wait for me, or explain other, like, the things for me... just to make sure I am on the same page and. yeah.

Nina: How yeah how did group work, so...how typical was it during group work that, like, the group was going at different paces?

Qian: I think, is normal, because, um, there, there is some of us, like, would try to finish the, like, the worksheet ahead of time. I don't know, like, Like, why did they do that? But, like, they try to, like, rush through the questions and then maybe, like, start the other worksheet, or like go home early, I don't know.

Nina: Okay, like some people kind of were really rushing through it, or even doing it ahead of time.... did they do it ahead? is it posted on, like, the canvas site ahead of time?

Qian: No, no, they just, like, they, like, read the problem, and then they say, like, obviously this is true, and then, let's go to another question.

Dick: And would they write something on the board? or they'd just write "obviously"?

Qian: Obviously.

Nina: yeah.

Dick: I see. that is where an instructor needs to step in. When it's just like stuff like that on the board instructor has to come slow the group down. yes, yeah, it sounds like your instructor did a good job of doing that.

Nina: Rory what were your experiences during group work?

Rory: um I definitely agree that um the groups at times had students going different speeds. Partway through the semester our instructor sent out a Google form asking if there were people that we felt we worked really well with and people that we felt, we just, you know, didn't really click with. And you could tell the issue is making the groups for the rest of the Semester, she was being intentional with that. um I really had no preference, and so I had just said I work well with these people, specifically, but I also just work well with everyone, it seems like. But I did notice that the groups were a bit more consistent. They weren't completely changing every class, which I could tell was really helpful. But I did notice that, because, um, I felt there are different skill levels with the class, um, because I felt other people had possibly taken it before. That some people did know the answers



fairly quickly, while it took others a few minutes to think through what the possible solutions were, how the proof would work. There are a few people who were really good at asking questions when they are confused or other people who would just, like, know the answer and right, you know one word or something or one solution and move on, whereas it was really more important to explain your answer. So I agree that there, there was a wide variety in class of students who wanted to work faster, or students who really wanted to ask questions and make sure that they knew the material.

Dick: Is ideas supposed to be that it's good for the students who want to write down just one word to have to explain themselves because, just I... we (a) intellectually and (b) because just writing down one word is not going to work on the exams. So yeah, So it is good for them to say wait a second what's, what .... how would you translate that word into three sentences?

Qian: yeah.

### **[[advice to their past selves]]**

Nina: Is there anything that you wish you had known ahead of time about the course, or is there any, like, advice you would give your past self about how to succeed in the course? Rory do you want to start us off?

Rory: This is a good question um I think that something that I do wish I would have recognized earlier is that um it's okay to be confused because it is a tough course and so it's okay to be confused, but just to know that it's also okay to ask questions about that confusion. I think that it took me a while to become, become comfortable with asking questions, especially in class, and so I did notice as soon as I started asking questions in class, um, I started to understand the content a little bit more. And, quite honestly, my midterm grades did increase a little bit as I became more comfortable with asking questions in class and expressing my confusion. Which was no one's fault, it was just because it was a tough course, and so my Professor was really helpful with that and making sure to address my confusion and other students' confusion as well.

Dick: I think, for a lot of students, especially in Michigan, who have always done really well, getting comfortable saying wrong things is really important, because you really can't get anywhere in math, or maybe in a lot of subjects, but especially in math, without, like, saying some wrong things. And there's a lot of wrong things which are said on the way to saying the right things. I think it is very important to be... I mean, it sounds great that your instructor did a good job of making you feel comfortable, to vocalize things that we're not totally correct yeah.

Nina: yeah absolutely. Qian, what about you? What advice would you give your past self?

Qian: Um, let me think.... Maybe, like, don't ever procrastinate. Because sometimes, like, I didn't finish one one worksheet and I think, like, like, maybe I can, like, finish myself, like sometimes later. And then I never go back. And then, like, before the exam, I find myself, like, I have, like, many things, many things I don't know and then there's no time for me to, like, to ask others or, like, the instructors like in that short of time.

Nina: These are the worksheets from class, like, if you didn't finish them....

Qian: yeah.

Nina: you wanted to more quickly get back to them and finish them?

Qian: yeah yeah.

### **[[biggest feedback on the course design]]**

Nina: um, What... if you were the designer of this course, like what, what is the first thing you would change about Math 217?... And you can take them over to think about it, I know that's a big question. But, like, what is the thing that you, in *your* opinion, is most in need of change?

Qian: Maybe webwork because, I, when i'm taking this course I don't see, like, obvious relation between webwork and the course material because, like..um... So I think I mostly study the, like the, like material for the Webwork and the gateway exam myself. Like, those calculations I, I think. But I don't see obviously relation between the gateway exam and like, the course material--- the proofs.

Dick: Of How does that mean you would like to see more of the computation is discussed in class? or you would like to see the same focus in class, but maybe less computational focus on the web work?

Qian: Less computation on web work.

Nina: Rory, What about you?

Rory: I think that I ...lemme think... I think that one thing that I struggled with was just teaching myself, um... especially just having the book. um...I do not learn, personally it's just a bit more challenging for me to learn from reading and then just doing problems, and so what I ended up doing honestly was just, um, finding videos online, like Khan academy or something just for a different explanation because throughout the Semester I just realized that the book wasn't very descriptive. So maybe, providing more different options for learning on our own, because I do understand it is very beneficial for us, you know, to learn outside the classroom and then, you know, apply it in the classroom with the proofs and stuff on the in-class worksheets, but I think that providing multiple options

for the outside learning might be beneficial just for those students that might not learn as well from reading.

Dick: Now did your instructor have what we sometimes call mini lectures?

Qian: hmm.

Rory: um at the beginning, she would go through a proof that was a pretty, you know, useful proof that we could use on the worksheet later that day or, you know, we could use that concepts... But, um, I guess that, in a way it did feel like a mini lecture, but it was always just proof-based it wasn't really going through just ...generic topics or anything if.

Dick: So it wasn't giving an overall, an overall discussion of what the thing was about, or what the topics was...

Rory: no, not exactly.

Dick: ...And that's, that's what you'd sort of like more of, an overall synthesis of: in this section we're learning this?

Rory: I think so yeah, just having it explained in a different way other than just having to read the textbook.

Dick: Okay.

### **[[biggest takeaways from the course]]**

Nina: um, my last question, and again this is one, you can take a minute to think about, is what were your biggest takeaways from math 217 and that could be content wise, or ways you learn to study, or something you learned about math in a more Meta way, but what were... what will you take away from the course that will kind of stay with you this semester or well beyond? You can take a moment to think about that.

...[background interruption]...

Nina: yeah Rory do you want to start us off?

Rory: yeah um, so like I had said, you know I did go to map up quite often, and I ended up having to find my own... you know, I used online resources like Khan academy and other videos, so I think that the biggest takeaway was probably finding resources when I was confused on myself, especially when, you know, the resources offered were pretty much just the textbook and the worksheets and the solutions to those worksheets, and so I think the biggest takeaway was just, you know, um, knowing when I do need help and what will be the most beneficial to help me with that issue.

Nina: that's great. That sounds really like a good skill for any class. Qian, what about you?

Qian: um this is sort of big, but like, math 217 like introduced me to, like, for the first time, like abstract math because before, like, before this class I was considering, like, majoring in statistics. I took math like 217 because I couldn't get a place in 214. And then, you know, yeah ...And before this class I don't even know, like, I think, on the first or second week I like I asked a question something like, like, "what is, like 'Proof by induction'?" and like, before this class I don't know, I don't even know what is proof by induction. But, like, after this class, I think I know, like, how abstract math works, so I stick with, like, math major and then i'm taking 451.

Nina: That's awesome.

Qian: yeah.

Nina: I had a similar experience in college with my first proof-based course, I just, I had no idea what I was taking and I liked it so much I just kept taking more so....[laughs]

Dick: I fact, I went to college under the feeling that I definitely did not want to be a math major. I was sure of that. I was also, my dad was an English professor, so I was very sure I did not want to be a professor. [laughs] Show how things work out.

Nina: Well, thank you both so much. Dick, you have any final questions?

Dick: um, just, you know, is there something that you think the department should know about 217, or their curriculum in general? just open ended Since we're looking at the whole curriculum, and you're both kind of the start of your journey through our curriculum, but if you have any thoughts, we'd love to hear them.

Nina: yeah 217 or 424, or 451. Or, or if there's other things you want to share that you think of afterward, you can also respond to my email, let us know that way as well.

Qian: yeah I got one quick question, so is, like, math 217 some sort of experiment? because I noticed, like, for the course in the fall, there are, like, two sets of worksheets and .... why do we need that.

Nina: [laughs] It's not an experiment. Dick, can you see my there're two sets of worksheets?

Dick: i'm actually teaching it this winter and it's, you know, mathematicians tend to be very independent and have their own ideas about, about these things. And there, there's now at the moment there's kind of three strands of worksheets working through, but they... I've looked at them, because i'm teaching it for the first time this semester and I mostly use one, but in today's class, I decided to use one from another strand and it was fine.

They're not so very different in terms of what they cover, it's often in terms of ordering and phrasing... Some of them have a more formal phrasing, and some have a little more colloquial phrasing. But, um, yeah I mean all those strands of worksheets or at least five years old, in fact.

Nina: yeah so what's happened is different people have come in, so this has been taught using this inquiry based learning for quite a few years now, but it's different people have kind of come in to the course they have, like, written their own they're like: "I don't like this one, so i'm going to do it this way" and.... yeah.

Qian: got it.

Dick: I think it's sort of stabilized. It used to... in the early years I think the level of difficulty the proof kind of varied a fair amount by the instructors and now in the last four or five years it's gotten very stable... looking back on exams from the last five years and they're pretty consistent in terms of level of difficulty, which wasn't true when it first got started 10 or 12 years... ago in this format.

Nina: Qian, were you saying something else?

Qian: yeah I thought it was, like, an experiment, because I felt like, like one set of work sheet is, like, a control group and then another was the experiment group. [laughs] yeah.

Nina: No, we weren't doing that you. It was just mathematicians and personal preferences, but it's a good idea, maybe we should try that! I mean....

Dick: It wouldn't... it wouldn't be nonsensical. We could make a conscious decision to try to figure out which worksheets work better for people, though, often you know there's worksheets which work better with different people's teaching styles, too.

Nina: Rory What about you do you have any final thoughts or questions?

Rory: Nothing I can think of. I think that, um, all of my, you know, reflections on the course were well reflected in all the questions that you asked today.

Nina: Great, um, well if you ever want to think about a different kind of math major you can also meet with a major advisor because actuarial is not the only one, you know so....

Rory: Thank you.

Nina: i'll put that out there, too, so yeah.

Dick: there's math bio, there's math econ, there's math physics there's math and stats ...

Nina: Actually there's two different math sciences that work really well with a computer science major: algorithmic methods one... and there's one other one as well. So, yeah since you've taken 217 and things, you could explore those kind of double majors.

Dick: there's also the math minor.

Nina: Yeah the math minor.

Dick: You have to have five courses and you have one or two now already so.

Rory: Something yeah i'll definitely have to continue looking at that as well.

Dick: yeah you can just go online and schedule a meeting with a math advisor and talk to them about it, yeah, and they're.... all those are all faculty or lecturers so they're, they're people who know a lot about the program.

Nina: You didn't know, Rory, that would be, like, math proselytizing, too. Yeah, thank you both so much for your, your reflections. I'm going to be in touch with you... i'll follow up about how you can get the target gift card. I'll email them to you, if possible, and, if not, they'll be waiting in the math office for you.

Nina: But you should hear from me by the end of the week with those details.

Rory: Thank you so much.