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MATH 435 Progress Report

Week 1:

Over the past week, I found the course to be very different in contrast with the previous math courses I’ve taken in the past as this is the highest-leveled math course I’ve ever enrolled in. I’ve discovered that this class is heavily research-based as we will not be diving too deep into new parts of calculus or algebra but rather incorporate previous knowledge from courses like differential equations into mathematical models related to infectious diseases. I comprehended the introduction to modelling as the professor gave a simple example and broke it down. However, I faced difficulty in the second class where our professor began to introduce graphs and phase lines. Furthermore, I read through the syllabus and noticed that any introductory differential equations class will benefit us tremendously for this course, thus I am at a disadvantage since I didn’t. Hence, I will be communicating with either him or the teaching assistant in the second week of class to apprehend this part better before he advances deeper into SIR models in our upcoming classes.

Week 2:

After the second week, I have gained a much better comprehension over the various mathematical models explored in class along with how we can use autonomous ODEs to compute the rate of changes from one area to another. We learned the simple SIR model at first, followed by applying similar concepts to other models like SIS and SIR models with birth and death rates. We also conducted some computations to see how many people will remain susceptible, infected or recovered as time progresses using infinity limits. I am not very familiar with estimating parameters from data yet as I only had sufficient time to discuss the basic rates of changes under mathematical models with my teaching assistant, hence am quite struggling with the homework as it is due the upcoming Monday. Furthermore, I am beginning to familiarize myself with simplifying these ODE’s and using them to find equilibria which can be applied to different cases during the phase line analysis to figure when the diseases persist or die out. Overall, the lines are starting to align, and I really appreciate the help of my lecturers and teaching assistants so I will begin to seek help from them more.

Week 3:

I found this week’s classes rather interesting. After learning the basics of ODE’s and several basic infectious disease models like SIR and SEIR, we have begun looking at more complex ones, learning how to modify them along with the ODE’s that make them work, like adding transition processes and different stages. Apart from that, I am a bit unfamiliar with R naught (basic reproduction number). The instructor tried explaining them using graphs but I still seem to be a little lost so I shall seek advice from him when I can. We can also learn other aspects like the differences between epidemic and endemic, transmission and translation, types of immunity, and have begun to look into the Covid Model.

Week 4:

As our instructor is still recovering from Covid, we have begun MATLAB tasks to get used to the syntax as we will be implementing lots of our work using this programming language for our final project. For the second class, a guest speaker, one of our professor’s formal PHD students, returned to UNL to brief us on the various diseases her and her company try to model. The mathematical models she presented were way more complex than the ones we’ve come across in class, but she made the complexity interesting to learn about. As our instructor returns, we will continue to learn more about Covid models.

Week 5:

The professor continued where he left off from the previous week as he continued to speak about the covid model, emphasizing on the differential equations for the complex model, the additional assumptions which make up the effective infectious population, the results that can be portrayed through graphs, and the various mitigation strategies to reduce infection rates. Furthermore, the founder of the Covid model we have been learning, Dr. Glenn Ladder, spent 2 of our classes to further talk about it, introducing new things like equilibriums, stability and Jacobian matrices. Our professor then told us he would discuss it more in the following week.

Week 6:

As mentioned in the previous report, the professor spoke about stability and how it can be determined from equilibriums. We solved them through simultaneous equations between the susceptible and infectious rate. We also learned about a mathematical test to determine the stability between certain intervals depending on the equilibriums we found and whether any parameters are given – using the Jacobian matrix. If the parameters are set, we can solve the matrix where all values are constant and calculate the eigenvalues, informing us whether the stability is local or global. I am not entirely sure how to measure these stabilities or what they represent so I will study these lectures more.

Week 7:

During the final week before spring break, it was time for us to discuss our final project. During the first class, we mainly brainstormed potential topics to research about. The professor gave his suggestions, followed by the students contributing some ideas as well. We were given 2 days to decide which topic we desired and on Wednesday, we had to give our first and second option. Most of us got the topics we wanted but there were 1 or 2 groups which were too full to accommodate everyone, hence they had to split a bit. For me, I chose researching how migration would affect the spread of a disease between 2 different countries. My group had 4 students including myself, so we were fine and did not have to move. On Friday, we were just roughly discussing how the flow of it will be. We had to prepare literature research, emphasizing what the math model would look like, our general prompts, methods to resolve the big question we must answer, etc.

Week 8:

Literature Research

Week 9:

For this week, since we got the literature research done, we have a better idea on which direction we intend to go with regarding our project. We began constructing how the base mathematical model would look like, followed by the differential equations to support it. We also thought of potential additions to the model that we could incorporate in the future to make it more complex, in case it is too simple, such as new classes like vaccination or a new direction from one class to another. We also did some more research on which disease we would like to investigate, as well as selecting the 2 countries and method of movement between them. At the end, we chose to research how the movement of tourists between Germany and France will affect the spread of Covid-19. On Friday, class was cancelled but we were tasked to complete a Latex exercise to get us comfortable with using the document preparation system.