Professor Gopalappa on Public Health and Mathematical Modeling
The screen read, “Goal 3: ‘Healthy lives for all at all ages,” and, underneath it, a list of factors impeding this goal. As students learned at the Pizza and Prof presentation entitled "Mathematical Modeling to Inform National Public Health Strategic Decisions" Tuesday December 4th, this goal—one of the UN Sustainable Development Goals—is difficult to achieve, but through mathematical modeling, not impossible.
At the beginning of her presentation, Dr. Chaitra Gopalappa, a Commonwealth Honors College Professor in industrial engineering, introduced the United Nations’ plan to achieve its mission to end poverty. Gopalappa explained that to end poverty, each of the seventeen societal aspects laid out by the U.N. need to be addressed, and mathematical modeling simplifies that process.

Disease, Dr. Gopalappa explained, is intertwined with the economy. Therefore, it needs to be approached as a resource allocation problem, and the question of how to optimally allocate resources has to be confronted.

In order to demonstrate how to investigate proper resource allocation with mathematical modeling, Gopalappa demonstrated modeling interacting factors on a final exam schedule. She demonstrated how food and sleep impact energy, how that affects every part of a student’s day, and how each in turn affects the other.

“I’m a microbiology major and I’m interested in infectious diseases,” said sophomore microbiology major Rebecca Leduc. “I thought it was cool that [Dr. Gopalappa] made models that address these problems because it’s easy to see how the models fit to different problems.”

Another example Gopalappa outlined was how understanding these factors is very important when looking at why low-to-middle income countries (LMICs) have seventy percent of the world’s premature deaths from cancer. Gopalappa showed a graph displaying levels of reported incidents and fatalities in high income countries and in LMICs. While reported incidents were dramatically higher in high income countries, the fatality rates were roughly the same. This indicates that people in LMICs die at a much higher rate from cancer even though it’s much less common. One critical reason for this is that the majority of cases in LMICs are diagnosed in later stages.

“I’m a double major — chemistry and public health — so I saw that this was incorporating a bit of public health but in a different flavor, so to speak. I wanted to see how it played out because this is a modeling mathematical type of public health that I’m not used to,” said Madeleine Niznikiewicz. “I am interested in health care systems in the United States and how they might be reformed to be better, so this kind of modeling is something that I really wanted to see, to see if I can apply it to my own interests.”

Nadia L’bahy, a sophomore biology and informatics major agreed; saying that she came to this talk to see how mathematical modeling and computational skills could help her solve biological problems.

“I’m especially interested in climate change,” said L’bahy. “So this talk was interdisciplinary in the best way possible because she was covering climate change and how it relates to humanitarian issues, and how we can solve those issues with mathematical modeling.”

Dr. Gopalappa’s research areas focus on biomedical and healthcare engineering, and dynamic systems and controls. Within these fields she focuses specifically on projecting future cases of HIV and other STIs and analyzing impact and cost-effectiveness of national intervention strategies. She has also worked on projects estimating the transition parameters for modeling the natural history of cancer and projecting disease burden. This upcoming spring semester she will be teaching Mechanical and Industrial Engineering 290H: “HIV, TB, and Malaria: Simulation Modeling to Address Public Health Problems,” and she is part of a lecture series for the political science course, "The Science of Health Inequalities: The Politics of Policy Intervention."

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