My name is Troy Day and I am a Professor in the Department of Mathematics and Statistics at Queen's University.

My research interests are in applied mathematics, particularly in mathematical biology. My work usually involves some combination of dynamical systems, optimization, stochastic processes and game theory. Here are a few problems that are currently on my research agenda.

Problem 1 How can we use mathematics to better design disease treatments strategies like antibiotics, vaccines, and chemotherapy? Are there certain types of therapeutic agents, or certain ways in which they can be administered over time, that minimize the likelihood of the evolution of treatment resistance while simultaneously maximizing treatment efficacy? These problems involve an interesting combination of stochastic processes, partial differential equations, and game theory.

Problem 2 How can we infer the properties of new genetic variants of infectious diseases using mathematical models? Often enormous amounts of epidemiological and genetic data are available during infectious disease outbreaks. Mathematical models of the spread of disease, coupled with models of genealogical processes, can be used to determine when a new variant has appeared as well as how it differs from existing variants.

Problem 3 How predictable is evolution? The evolution of any population results from a combination of deterministic dynamical processes and the stochastic appearance of new variants. In addition to the probabilistic challenges associated with making evolutionary predictions there can also be fundamental limitations on our ability to make predictions that have close connections to computability theory and mathematical logic.