James "Mac" Hyman

Evelyn and John G. Phillips Distinguished Professor in Mathematics at Tulane University
New Orleans, LA, US

James "Mac" Hyman works to build a solid mathematical foundation for difference approximations to partial differential equations

Biography

My research interests include building a solid mathematical foundation for difference approximations to partial differential equations and using mathematical models to better understand and predict the spread of epidemics. Statistical and Numerical Analysis: My research is the creation and analysis of more accurate and efficient numerical algorithms to characterize multivariate functions when we have the ability to sample the function at a very few data points. My approach is to adaptively quantify the uncertainty in the desired quantities of interest, such as the approximation, integration, or optimization of the unknown function, as a function of the sample points. That is, a desired distribution of sample points is adaptively updated during the sampling process based on the existing sample values. Low-discrepancy algorithms are used to generate the future sample points based on both the current and desired sample distributions. Mathematical Epidemiology: We create, and analyze, mathematical models that can capture the role of heterogeneity in disease transmission and impact of disease mitigations on its spread. My research includes the mathematical analysis of small-scale compartmental differential equation transmission models, risk-based transmission models, and large-scale (millions of agents) individual-based models, such as the Los Alamos EpiSimS code. The goal of these efforts has always been to create mathematical models that can help the public health community understand and anticipate the spread of an infection and evaluate the potential effectiveness of different approaches for bringing it under control. A key aspect of my research is to identify effective approaches to quantify uncertainty in forecasts as a function of the model assumptions. The epidemiological data for disease outbreaks are incomplete and inaccurate. Infection forecasts based on inaccurate data are useless unless the uncertainties in the predictions can be quantified in terms of the available data and the model assumptions, such as the behavior of the infected population. These techniques can help identify which data would be most useful in estimating the current prevalence, the risk of infection, and the effectiveness of potential mitigation programs.

Areas of Expertise

Coronavirus, Epidemics, Life Sciences, Statistical Modeling, Disease Management, COVID-19

Education

Courant Institute of Mathematical Sciences
Ph.D. Mathematics

Courant Institute of Mathematical Sciences
M.S. Computer Science and Mathematics

Tulane University
B.S. Physics

Tulane University
B.S. Mathematics
