BRIN MATHEMATICS RESEARCH CENTER

Disease Dynamics and Human Behavior

November 18-22, 2024

About the Workshop

This workshop gathers interdisciplinary researchers (including mathematicians, epidemic modelers, and behavioral scientists) to explore the interplay between human behavior and disease dynamics and how to translate principles of coupled dynamics for public health benefit. The Fall 2024 workshop is part of a series of activities exploring the interface between human behavior and disease dynamics, building upon a Spring 2023 workshop organized by Bill Fagan and Abba Gumel.

Illustration: 'Us' by Mary Wang with Dr. Stephen Beckett (2021)

Organizers

Henri Berestycki, University of Maryland & EHESS Paris

Mallory Harris, University of Maryland

Joshua Weitz, University of Maryland

Participants

Folashade Agusto, University of Kansas

Shweta Bansal, Georgetown University

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Cynthia Baur, University of Maryland

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Alex De Figueiredo, LSHTM

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Brooke Fisher Liu, University of Maryland

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Sana Jahedi, University of Maryland

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Arnaja Mitra, University of Maryland

Alice Oveson, University of Maryland

Shigui Ruan, University of Miami

Allie Sinclair, University of Pennsylvania

Aravind Srinivasan, University of Maryland

Jorge X. Velasco-Hernandez, UNAM

Jianhong Wu, York University

Jim Yorke, University of Maryland

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DEPARTMENT OF MATHEMATICS

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Schedule at a Glance

	Monday	Tuesday	Wednesday	Thursday	Friday
8:00					
	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast
9:00	Bauch	Marathe	De Figueiredo	Charge for the day, group discussion	White paper development
	LeJeune	Beckett	Pullano		
10:00	Sinclair	Ferretti	Yashiv		
	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break
11:00	Ruan	Wu	Feng	White paper development	Concluding session and open discussion
	Velasco-Hernandez		Levin		
12:00	Lunch	Lunch		Lunch	
			Lunch on your own		
13:00	Dushoff	Griette		White paper development	
	Berestycki	Agusto			
14:00	Demers	Yorke	Sinclair		
	Coffee Break	Group photo		Bansal *in BRB 1103*	
15:00	Baur	Breakout discussions	Afternoon on your own		
	Fisher Liu			Coffee break	
16:00	Harris			White paper development	
	Wrap-up				
17:00	MIDAS reception	Conference Dinner		High Tea	
18:00					

All talks will be held in the Brin MRC center, located on the fourth floor of the CSIC building.
Except for Bansal's lecture which will take place in the Biosciences Research Building, room, 1103.

Workshop Overview

This workshop gathers interdisciplinary researchers (including mathematicians, epidemic modelers, and behavioral scientists) to explore the interplay between human behavior and disease dynamics and how to translate principles of coupled dynamics for public health benefit. The Fall 2024 workshop is part of a series of activities exploring the interface between human behavior and disease dynamics, building upon a Spring 2023 workshop organized by Bill Fagan and Abba Gumel.

Organizing committee

Henri Berestycki University of Maryland & EHESS Paris

Mallory Harris, University of Maryland

Joshua Weitz, University of Maryland

Workshop Schedule

Monday, November 18, 2024

8:15 - 8:45	Breakfast
8:45 - 9:00	Doron Levy (University of Maryland/Director, Brin MRC) *Opening*
9:00 - 9:30	Chris Bauch (University of Waterloo) *Dealing with Real-World Complexity in Coupled Behavior-Disease Models*
9:30 - 10:00	Leah LeJeune (Virginia Tech) *Mathematical Analysis of Simple Behavioral Epidemic Models*
10:00 - 10:30	Allie Sinclair (University of Pennsylvania) *Psychological Interventions to Motivate Preventative Health Behaviors*
10:30 - 11:00	Coffee Break
11:00 - 11:30	Shigui Ruan (University of Miami) *Spatiotemporal Dynamics in Epidemic Models with Levy Flights: A Fractional Diffusion Approach*
11:30 - 12:00	Jorge X. Velasco-Hernandez (Universidad Nacional Autonoma de Mexico) *The Effect of Imperfect Vaccination and Vaccine Coverage on the Existence of Multiple Endemic Equilibria*
12:00 - 1:15	Lunch
1:15 - 1:45	Jonathan Dushoff (McMaster University) *Interpreting Data For Acute Respiratory Infections: What Can We Infer From Viral Testing Data?*
1:45 - 2:15	Henri Berestycki (University of Maryland & EHESS, Paris) *Modeling Epidemics With Heterogeneity of Behaviors and Social Diffusion*

2:15 - 2:45	Jeffery Demers (University of Maryland) *Behavioral Inertia in the Dynamic Response to Risk Perception*
2:45 - 3:15	Coffee Break
3:15 - 3:45	Cynthia Baur (University of Maryland) *Fear, Confusion, and Comprehension: Health Literacy's Role in Disease Dynamics and Decisions about Protective Actions*
3:45 - 4:15	Brooke Fisher Liu (University of Maryland) *Panic, Perish or Prosper? The Essential Elements of Risk Communication for Crisis Readiness*
4:15 - 4:45	Mallory Harris (University of Maryland) *Social Divisions and Risk Perception Drive Divergent Epidemics*
4:45 - 5:15	Wrap-up
5:15 - 7:00	MIDAS reception and poster session, Silver Spring Maryland

Tuesday, November 19, 2024

8:30 - 9:00 Breakfast

9:00 - 9:30 Madhav Marathe (Virginia Tech)
Computational Socio-Behavioral Epidemiology

9:30 - 10:00 Stephen Beckett (University of Maryland)
Developing Public-Facing Pandemic Tooling to Promote Prosocial Decision Making

10:00 - 10:30 Luca Ferretti (University of Oxford)
Insights into Drivers of Transmission Risk and Epidemic Dynamics from Digital Contact Tracing

10:30 - 11:00 Coffee Break

11:00 - 12:00 Jianhong Wu (York University)
Predict The Unpredictable Behavior and Decision-Making Dynamics During a Public Health Emergency

12:00 - 1:15 Lunch

1:15 - 1:45 Quentin Griette (Universite Le Havre Normandie)
Reconstructing the COVID-19 Pandemics: Insights from Differential Equations

1:45 - 2:15 Folashade Agusto (University of Kansas)
Leveraging Mobility Data to Model Drug Overdose Mortality in the United States during COVID-19 Pandemic

2:15 - 2:45 Jim Yorke (University of Maryland)
Simple Models of SIR-Like Epidemics

2:45 - 3:15 Group photo

3:15 - 5:15 Breakout discussions

5:15 - 7:00 Conference Dinner

Wednesday, November 20, 2024

8:30 - 9:00	Breakfast
9:00 - 9:30	Alex De Figueiredo (London School of Hygiene & Tropical Medicine) *How Has the Pandemic Shaped Vaccine Confidence?*
9:30 - 10:00	Giulia Pullano (Georgetown University) *Integration of High-Resolution Mobility Data into Mathematical Models for Disease Prevention and Control*
10:00 - 10:30	Eran Yashiv (Tel Aviv University) *Optimal Pandemic Management Policy: Macroeconomic and Public Health Impacts*
10:30 - 11:00	Coffee Break
11:00 - 11:30	Zhilan Feng (National Science Foundation) *NSF Funding Opportunities on Mathematical Biology*
11:30 - 12:30	Simon Levin (Princeton University) *Political Polarization, Social Behavior and the Dynamics of Infectious Diseases*
12:30 - 2:00	Lunch on your own
2:00 - 3:00	Allie Sinclair (University of Pennsylvania) *Optional Primer: Prolific Experiments*
3:00 - 6:00	Break - afternoon on your own

Thursday, November 21, 2024

8:30 - 9:00	Breakfast
9:00 - 10:30	Charge for the day, group discussion
10:30 - 11:00	Coffee Break
11:00 - 12:00	White paper development
12:00 - 1:15	Lunch
1:15 - 2:15	White paper development
2:30 - 3:30	Shweta Bansal (Georgetown University)
3:30 - 4:00	Coffee break
4:00 - 5:15	White paper development
5:15 - 6:00	High Tea
6:00 - 7:30	Happy hour at The Hall

Friday, November 22, 2024

8:30 - 9:00	Breakfast
9:00 - 10:30	White paper development
10:30 - 11:00	Coffee Break
11:00 - 12:00	Concluding session and open discussion

Abstracts of talks

Dealing with Real-World Complexity in Coupled Behavior-Disease Models

Chris Bauch

University of Waterloo

Monday, November 18, 2024 @ 9:00 AM

Distilling sociological, economic, and psychological theories into coupled behavior-disease models requires simplifying assumptions that can change the original meaning of the theory. On the other hand, this process can also highlight similarities and create a common framework for thinking about modeling human behavior. I will frame some previous and current research in terms of two questions. When are different mathematical models actually the same? When are different social, psychological and economic theories actually the same?

Mathematical Analysis of Simple Behavioral Epidemic Models

Leah LeJeune

Virginia Tech

Monday, November 18, 2024 @ 9:30 AM

Since the onset of the pandemic, many models were created to understand the spread of COVID-19 throughout different populations. However, COVID-19 has a variety of complexities impacting its trajectory; as a result, many models have poor predictive abilities for estimating caseloads and deaths. One major component central to improving forecasting is developing an effective method for considering the impact of human behavior on disease transmission. A variety of models emerged which explicitly built human behavior into COVID-19 models, often coupling models for human behavior dynamics and disease dynamics. This work considers human behavior in the form of risk response, where humans change their actions in response to their perception of likelihood of infection (or death due to infection). Models are classified based on how human response to new information (risk responsiveness) affects disease transmission within the model, either exogenously (transmission is driven externally) or endogenously (transmission is driven internally). To better understand the impact of human behavior on mathematical models, we perform an in-depth mathematical examination of exogenous and endogenous versions of a simple SEIR model; we additionally consider two further variations of these models with respect to waning immunity. We perform various types of mathematical analyses on each model and compare the abilities of each model to replicate COVID-19 data. Endogenous incorporation of human behavior is shown to significantly improve model performance, and the assumption of waning immunity in models allows for richer model dynamics.

Psychological Interventions to Motivate Preventative Health Behaviors

Allie Sinclair

University of Pennsylvania

Monday, November 18, 2024 @ 10:00 AM

In order to protect ourselves and others, we must learn to evaluate health risks. Beliefs about the risk of viral exposure, infection, and severe disease are crucial for motivating health behaviors that reduce disease transmission (e.g., isolation, testing, masking, and vaccination). In this talk, I will explore the consequences of risk perception for individuals, social networks, and public health outcomes. Drawing on insights from the COVID-19 pandemic, I integrate diverse evidence from surveys, psychological experiments, and online field studies. Taken together, this rich body of evidence highlights three key ideas: 1) Beliefs about risk shape preventative health behaviors. 2) Psychological interventions can correct risk perception by contextualizing risk and providing tailored feedback. 3) Online interventions and evidence-based communication campaigns have the potential to change health beliefs and behavior at scale.

Spatiotemporal Dynamics in Epidemic Models with Levy Flights: A Fractional Diffusion Approach

Shigui Ruan

University of Miami

Monday, November 18, 2024 @ 11:00 AM

Recent field and experimental studies show that mobility patterns for humans exhibit scale-free nonlocal dynamics with heavy-tailed distributions characterized by Levy flights. To study the long-range geographical spread of infectious diseases, in this paper we propose a susceptible-infectious-susceptible epidemic model with Levy flights in which the dispersal of susceptible and infectious individuals follows a heavy-tailed jump distribution. Owing to the fractional diffusion described by a spectral fractional Neumann Laplacian, the nonlocal diffusion model can be used to address the spatiotemporal dynamics driven by the nonlocal dispersal. The primary focuses are on the existence and stability of disease-free and endemic equilibria and the impact of dispersal rate and fractional power on spatial profiles of these equilibria. A variational characterization of the basic reproduction number R_0 is obtained and its dependence on the dispersal rate and fractional power is also examined. Then R_0 is utilized to investigate the effects of spatial heterogeneity on the transmission dynamics. It is shown that R_0 serves as a threshold for determining the existence and nonexistence of an epidemic equilibrium as well as the stabilities of the disease-free and endemic equilibria. In particular, for low-risk regions, both the dispersal rate and fractional power play a critical role and are capable of altering the threshold value. Numerical simulations were performed to illustrate the theoretical results. (Based on G. Zhao & S. Ruan, J. Math Pures Appl. 2023).

The Effect of Imperfect Vaccination and Vaccine Coverage on the Existence of Multiple Endemic Equilibria

Jorge X. Velasco-Hernandez

Universidad Nacional Autonoma de Mexico

Monday, November 18, 2024 @ 11:30 AM

We propose a model that accounts for two types of imperfect vaccines: one that fails in degree (leaky vaccine) and one that fails intake (all-or-nothing vaccine). Vaccinated individuals are split into those who acquire immunity from the vaccine and those who do not. Immune-vaccinated individuals are assumed to be fully protected from infection during the period in which the vaccine is effective. On the other hand, due to the vaccine's degree of failure, non-immune vaccinated individuals can still become infected, albeit at a different rate than susceptible individuals. We further assume that individuals who receive the vaccine may not adhere to prevention and mitigation measures for the disease. We explore the consequences of these factors on the existence of multiple endemic equilibria.

Interpreting Data For Acute Respiratory Infections: What Can We Infer From Viral Testing Data?

Jonathan Dushoff

McMaster University

Monday, November 18, 2024 @ 1:15 PM

Interpreting patterns of respiratory infections is greatly complicated by patterns of testing. What does it mean, for example, when the number of positive flu tests is increasing while the percent positivity is decreasing? What factors affect testing rates, what subset of people get tested, and what information can be used to disentangle patterns of disease incidence from patterns of care-seeking and testing? I will discuss some COVID-era patterns, and some possible approaches.

Modeling Epidemics with Heterogeneity Of Behaviors and Social Diffusion

Henri Berestycki

University of Maryland & EHESS, Paris

Monday, November 18, 2024 @ 1:45 PM

I will present a system extending the SIR classical model by including a continuous variable describing diverse behaviors (or, more generally susceptibilities) of individuals. Furthermore, the distribution of this trait is subject to random variations. This model leads to a reaction-diffusion system. I will discuss the derivation of this model and some of its features. In a particular framework, one can derive an approximation in the form of the SIR system with an additional equation for the average of this trait in the population. We were led to this system from observations of wastewater measurements in the South of France. Even, in its simplified form, this system accounts for a much richer dynamics and exhibits plateaus and rebounds. I report here on joint work with Benoit Desjardins, Joshua Weitz and Jean-Marc Oury.

Behavioral Inertia in the Dynamic Response to Risk Perception

Jeffery Demers

University of Maryland

Monday, November 18, 2024 @ 2:15 PM

Inertia in human behavior and decision making (i.e., the tendency to resist change and repeat past behavior regardless of outcomes or changing circumstances) is a ubiquitous phenomenon observed across scales, from the choices of single individuals to the aggregate actions of groups, institutions, and nations, throughout the social and psychological sciences. However, the impact of inertia on the behavioral response to disease-related risk has yet to be systematically incorporated and analyzed within many mathematical frameworks utilized in behavioral-epidemiological modeling. Here, we incorporate inertia into the utility function modeling framework and leverage connections between optimal control theory and physics to assess it's influence on social activity in the presence of perceived risk. Utilizing early COVID pandemic mobility data, we find that the perceived cost of change in and of itself has a greater impact on behavior than the actual outcomes of those changes. State-level mobility data points to possible socio-economic drivers of behavioral inertia differences observed across the United States. Collectively, our results suggest possible avenues of behavioral science research to prioritize for improving the applicability and accuracy of mathematical modeling efforts.

Fear, Confusion, and Comprehension: Health Literacy's Role in Disease Dynamics and Decisions about Protective Actions

Cynthia Baur

University of Maryland

Monday, November 18, 2024 @ 3:15 PM

The information people have access to, how they make sense of it, and the decisions that follow intersect with disease dynamics and consequences for human health. Whether or not people perceive news of emergent or recurring diseases as worth their attention reflects personal, organizational, and community health literacy. Research shows that people may fear, distrust, or ignore what they don't understand, and situations of high uncertainty with novel or unpredictable diseases can magnify people's emotions, reactions, and behaviors. In this talk, I will illustrate the relevance of health literacy for disease dynamics with examples from the 2009 H1N1 influenza pandemic, 2014-2016 Ebola Virus Disease outbreak, 2015-2016 Zika Virus Disease outbreak, and 2019-2023 COVID-19 global pandemic. I will show how health literacy techniques can help people assess information, situations, and protective responses for infectious diseases.

Panic, Perish or Prosper? The Essential Elements of Risk Communication for Crisis Readiness

Brooke Fisher Liu

University of Maryland

Monday, November 18, 2024 @ 3:45 PM

A key failure of the COVID-19 pandemic was ineffective risk and crisis communication. While widely recognized, this failure did not have to occur. In this talk, Dr. Brooke Liu will cover the essential elements of risk communication that can contribute to crisis readiness, or the capacity for organizations, communities, and individuals to survive and thrive during crises like pandemics, tornadoes, and other disasters.

Social Divisions and Risk Perception Drive Divergent Epidemics

Mallory Harris

University of Maryland

Monday, November 18, 2024 @ 4:15 PM

During infectious disease outbreaks, individuals may adopt protective measures like vaccination and physical distancing in response to awareness of disease burden. Prior work showed how feedback between epidemic intensity and awareness-based behaviour shape disease dynamics. These models often overlook social divisions, where population subgroups may be disproportionately impacted by a disease and more responsive to the effects of disease within their group. We develop a compartmental model of disease transmission and awareness-based protective behaviour in a population split into two groups to explore the impacts of awareness separation (relatively greater in- vs. out-group awareness of epidemic severity) and mixing separation (relatively greater in- vs. out-group contact rates). Using simulations, we show that groups that are more separated in awareness have smaller differences in mortality. Fatigue (i.e. abandonment of protective measures over time) can drive additional infection waves that can even exceed the size of the initial wave, particularly if uniform awareness drives early protection in one group, leaving that group largely susceptible to future infection. Counterintuitively, vaccine or infection-acquired immunity that is more protective against transmission and mortality may indirectly lead to more infections by reducing perceived risk of infection and therefore vaccine uptake. These results illustrated how feedback between behaviour and disease can fundamentally alter disease dynamics. We close by discussing how data from surveys and social media may be applied to build more realistic models of human behaviour and infectious diseases.

Computational Socio-Behavioral Epidemiology

Madhav Marathe

Virginia Tech

Tuesday, November 19, 2024 @ 9:00 AM

COVID-19 represents the first pandemic since the H1N1 outbreak more than a decade ago. COVID-19 epidemic continues to evolve four years after it started; but it is undeniable that the pandemic had severe economic, social, and health impact. Pandemics such as COVID-19 are intertwined with social, political and economic considerations and in fact they co-evolve. The fear and anxiety caused by a pandemic is inherently a social phenomenon. It drives the pandemic and the economic policies and outcomes. Similarly mask wearing, vaccination acceptance, vaccine nationalism are driven by individual and collective behaviors. Political actions, individual and collective behavior and public policies by governments are not only governed by facts but public perceptions, fear, anxiety and the need to demonstrate concrete action by leaders to infuse confidence in citizens. In this talk I will outline a program in computational socio-behavioral epidemiology — the transdisciplinary program aims to understand the interplay between epidemic and socio-behavioral systems with the overarching goal of developing comprehensive implementation strategies to curb outbreaks. Development of computational models to support real-world questions will be discussed during the talk.

Developing Public-Facing Pandemic Tooling to Promote Prosocial Decision Making

Stephen Beckett

University of Maryland

Tuesday, November 19, 2024 @ 9:30 AM

Responding effectively to infectious disease outbreaks, such as COVID-19, requires real-time estimates of disease transmission. This information can be utilized in decision making for logistics and policy-making, as well as for informing individual risk assessments. Clinically determined cases can under-ascertain disease incidence, as they are biased by testing availability, accessibility, and towards those more likely to be symptomatic. Such biases may change across time and across regions. Community wastewater monitoring offers a promising alternative approach to estimating disease prevalence that is subject to fewer logistical and behavioral factors, however converting measured viral copies in wastewater into population-level prevalence diagnostics is non-trivial. Despite these challenges, in comparing wastewater prevalence estimates against household surveillance infection estimates in Scotland we find a high degree of concordance across disease regimes and viral variants. In the context of our COVID-19 research, I will discuss some methods and challenges associated with prevalence estimation; and how such information can be translated and communicated to the public to promote prosocial behavior change via online dashboards. Our work highlights the potential for combining epidemiological data via models with digital design tools for facilitating behavior change and pandemic prevention.

Insights into Drivers of Transmission Risk and Epidemic Dynamics from Digital Contact Tracing

Luca Ferretti

University of Oxford

Tuesday, November 19, 2024 @ 10:00 AM

Digital contact tracing is a new public health tool developed and deployed worldwide during the COVID-19 pandemic. Beyond their epidemiological impact as public health interventions, apps such as the NHS COVID-19 app can reveal individual and population determinants of transmissions. Their capabilities for precision epidemic monitoring at scale also offer unprecedented insights into drivers of epidemic dynamics, including early indications of changes in population contact rates and transmission risks. To illustrate these capabilities, we will present a high-resolution picture of the drivers of the COVID-19 epidemic during 2021-2022 in England and Wales.

Predict The Unpredictable Behavior and Decision-Making Dynamics During a Public Health Emergency

Jianhong Wu

York University

Tuesday, November 19, 2024 @ 11:00 AM

The 4th industrial revolution is characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres, and calls for response that must be integrated and comprehensive. This will potentially elevate the role of mathematics from the Queen of Science to Empress of all Disciplines. I will take a retroactive approach to look at the widely observed multi-wave phenomena during the three global public health emergencies of the century (2002-04 SARS Outbreak, 2009-10 Influenza pandemic, COVID-19 pandemic) to illustrate an powerful integrative role of mathematical (dynamical) modeling and big data analytics in understanding the interaction of individual behavioral adaptation, public health decision making, information propagation, and disease transmission during a global public health emergency. It is hoped that an integrative framework of dynamical modeling, deep learning neural networks, and symbolic regression will enable us to identify mechanisms behind complex data of behavioural changes and decision making, and to translate big data into knowledge in precision public health to empower comprehensive response to future public health emergencies.

Reconstructing the COVID-19 Pandemics: Insights from Differential Equations

Quentin Griette

Universite Le Havre Normandie

Tuesday, November 19, 2024 @ 1:15 PM

We present several methods and models developed to understand the progression of the SARS-CoV-2 epidemic. Since the beginning of the pandemic, various parameter estimation techniques have been proposed to fit mathematical models to publicly available cumulative case data. This work focuses on deterministic approaches that fit observed data patterns using simple but meaningful differential equation models, such as the SIR model and its extension, the SIUR model, which accounts for hidden cases. We explore a range of methods, starting with an exponential fit to early-stage data, which provides key parameter estimates, and progressing to partial differential equations with the Kermack-McKendrick model incorporating the age of infection. Special attention is given to a phenomenological model, the Bernoulli-Verhulst model, which effectively captures the dynamics of a single-wave epidemic. Finally, we present a global approach for reconstructing consistent epidemiological models that account for successive epidemic waves, based on cumulative case data.

Leveraging Mobility Data to Model Drug Overdose Mortality in the United States during COVID-19 Pandemic

Folashade Agusto

University of Kansas

Tuesday, November 19, 2024 @ 1:45 PM

Drug overdose fatalities have become a significant health issue in many countries, with the United States experiencing a particularly alarming rise over the past two decades. In this study, we examine the geographical patterns of drug overdose deaths at the county level across the United States by utilizing five newly defined spatial weights, developed using mobility data from Google and Facebook. Google Mobility Data, derived from users' location services, provides insights into how populations move between various categories of places, while Facebook Mobility Data, collected through its Data for Good program, tracks population movements between geographic areas. These spatial weights are based on the correlation of mobility data between two spatial units and a threshold distance decay between them. We analyze the spatial distribution of drug overdose deaths using datasets from County Health Rankings and Roadmaps, as well as the Centers for Disease Control and Prevention, focusing on the COVID-19 era spanning 2020, 2021, and 2022. By incorporating spatial covariate information into the new spatial weight definitions, these methods more accurately represent the relationships between spatial units and enhance the performance of spatial analysis techniques. Three of the methods effectively captured nearly all high-incident counties and accurately identified hot and cold spot clusters over the years. In contrast, the other two methods failed to identify many counties with high cases, classifying them as insignificant.

Simple Models of SIR-Like Epidemics

Jim Yorke

University of Maryland

Tuesday, November 19, 2024 @ 2:15 PM

I will describe how an SIR can fit an epidemic with a wide range of parameters. This poses challenges when quantification of the number of susceptible individuals is not feasible. Making the model more complex does not help with this problem. The talk will be based on the following: Shayak, B., Jahedi, S., & Yorke, J. A. (2024). Ambiguity in the use of SIR models to fit epidemic incidence data. ArXiv. /abs/2404.04181

How Has the Pandemic Shaped Vaccine Confidence?

Alex De Figueiredo

London School of Hygiene & Tropical Medicine

Wednesday, November 20, 2024 @ 9:00 AM

The Covid-19 vaccine is one of science's most remarkable recent success stories. Despite this achievement, the rollout of the vaccine at times proved controversial and many were strongly opposed to vaccination. In this talk, Dr. Alex de Figueiredo, assistant professor in the Department of Infectious Disease Epidemiology at LSHTM will outline pandemic-era research conducted by the Vaccine Confidence Project (VCP). In recent years, the VCP has been dedicated to monitoring public perceptions towards the Covid-19 vaccine as well as monitoring global trends in vaccine confidence. Dr de Figueiredo will discuss several key research themes explored by the VCP during the pandemic including: (1) the impact of misinformation: how misinformation affected people's willingness to receive the Covid-19 vaccine; (2) predicting vaccine uptake: how future vaccination coverage can be accurately predicted local levels; (3) policy backlash: what has the impact of Covid-19 vaccination policies, such as vaccine mandates and passports, been? And (4) global shifts in confidence: how has vaccine confidence changed globally throughout the pandemic? The talk will conclude with reflections on the lessons learned from the Covid-19 pandemic. An open area of discussion, and one that Dr de Figueiredo hopes can be explored through discussion, is how attitudinal data can be integrated with epidemiological modelling to improve predictions of future disease burdens and make meaningful predictions of the magnitude of policy backlash effects.

Integration of High-Resolution Mobility Data into Mathematical Models for Disease Prevention and Control

Giulia Pullano

Georgetown University

Wednesday, November 20, 2024 @ 9:30 AM

Human behavior is a key driver of infectious disease dynamics, significantly influencing encounter probabilities, exposure patterns, and disease propagation both locally and globally. While long-range movements contribute to pathogen importation, short-range mobility and local contact structures play a crucial role in amplifying epidemics. Understanding mobility patterns and social mixing across various scales is essential for elucidating the emergence and spread of infectious diseases, thereby informing effective prevention and control strategies. The COVID-19 crisis catalyzed a data-sharing revolution, with network operators and tech giants like Google, Apple, and Facebook providing real-time aggregated mobility data derived from mobile phone traces to monitor human movement and combat the pandemic. This shift has spurred epidemiological research to develop innovative mathematical and computational frameworks that integrate high-resolution mobility data into models, facilitating both retrospective analyses and real-time epidemic monitoring. In this talk, I will explore how we utilized these data to address critical public health questions during the COVID-19 pandemic and discuss their growing relevance in the context of climate change, particularly regarding the rise of natural disasters and their impact on human behavior and disease dynamics.

Optimal Pandemic Management Policy: Macroeconomic and Public Health Impacts

Eran Yashiv

Tel Aviv University

Wednesday, November 20, 2024 @ 10:00 AM

I present collaborative work analyzing the optimal policy response in future pandemics, focusing on public health-economics trade-offs. S pecifically, we se ek to st udy ho w to ma nage a suitable balance of mortality rates vs. economic costs related to induced lockdowns of a society under pandemic conditions. In the model, a social planner minimizes the welfare loss caused by the disease through use of employment reduction policies. We find t hat a lthough t he o ptimal control policy keeps effective R (the r eproduction p arameter) a round 1 t hrough m ost o f t he planning horizon, it is highly fragile to uncertainty in parameter estimates - as is inevitably the case - leading to significant i ncreases i n w elfare l oss. I n c ontrast, w e i dentify a f easible f eedback policy that can limit disease spread and improve economic outcomes that is robust to uncertainty in estimates of disease features and the link between behavior and economic restrictions. I discuss ways to leverage lessons learned in developing robust policy to respond to future pandemics.

NSF Funding Opportunities on Mathematical Biology

Zhilan Feng

National Science Foundation

Wednesday, November 20, 2024 @ 11:00 AM

Political Polarization, Social Behavior and the Dynamics of Infectious Diseases

Simon Levin

Princeton University

Wednesday, November 20, 2024 @ 11:30 AM

We live in an increasingly polarized world, both domestically and internationally, and this polarization has consequences for our ability to address global problems, including infectious diseases. In this lecture, I will begin with discussion of trends and causes, explore the consequences for disease management, and conclude with some discussion of possible pathways to reducing polarization.

Optional Primer: Prolific Experiments

Allie Sinclair

University of Pennsylvania

Wednesday, November 20, 2024 @ 2:00 PM

TBD

Shweta Bansal

Georgetown University

Thursday, November 21, 2024 @ 2:30 PM

The Brin Mathematics Research Center

The Brin Mathematics Research Center is a research center that sponsors activity in all areas of pure and applied mathematics and statistics. The Brin MRC was funded in 2022 through a generous gift from the Brin Family. The Brin MRC is part of the Department of Mathematics at the University of Maryland, College Park.

Activities sponsored by the Brin MRC include long programs, conferences and workshops, special lecture series, and summer schools. The Brin MRC provides ample opportunities for short-term and long-term visitors that are interested in interacting with the faculty at the University of Maryland and in experiencing the metropolitan Washington DC area.

The mission of the Brin MRC is to promote excellence in mathematical sciences. The Brin MRC is home to educational and research activities in all areas of mathematics. The Brin MRC provides opportunities to the global mathematical community to interact with researchers at the University of Maryland. The center allows the University of Maryland to expand and showcase its mathematics and statistics research excellence nationally and internationally.

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