

# Appilineni Kushal

Teaching Assistant, Department of Mathematics and Statistics,  
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Applied mathematician, interested in modelling, analyzing and making predictions about complex systems

## Publications

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- **Appilineni Kushal**, Michael Springborn, Fernanda Valdivinos. "Assessing Impacts of Bycatch Policies and Fishers' Heterogeneous Information on Food Webs and Fishery Sustainability". submitted to **Philosophical Transactions of the Royal Society B (2024)** .
- **Appilineni Kushal**, Alan Hastings. "Effect of Migrations on Synchrony in Host-Parasitoid system." submitted to **Journal of Theoretical Biology (2024)** .
- Sabiha Majumder, Ayan Das, **Appilineni Kushal**, Sumithra Sankaran, Vishwesha Guttal. "Finite-size effects, demographic noise, and ecosystem dynamics" . **Eur. Phys. J. Spec. Top. (2021)** .
- V. Sasidevan, **Appilineni Kushal**, Sitabhra Sinha. "When big data fails: Adaptive agents using coarse-grained information have competitive advantage". **Physical Review E. 98(2) - Rapid Communication (2018)**.

\*This paper was selected as **Editor's suggestion** for the August 2018 issue

- **Appilineni Kushal**, V. Sasidevan, Sitabhra Sinha "Information Asymmetry and the Performance of Agents Competing for Limited Resources". **Econophysics and Sociophysics: Recent Progress and Future Directions, 113-123 (2017)** .

## Scholastic Achievements

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- **Teaching award for outstanding contributions to the development of the core coursework for the Quantitative Biology major (2023)**
- **Recipient of Math Departmental Fellowship (2019 - present, one quarter/year)**
- **IIT-JEE (2013) , All India Rank - 30**
  - IIT-JEE is the entrance exam for Indian Institute of Technology, which's the premier institute in India for an undergraduate in Engineering. It's written by over 1.5 million students all over the country ( ~ 100 percentile)
- **Kishore Vaigyanik Protsahan Yojna (KVPY) Scholar (2011–2018)**
  - KVPY is a National Fellowship Program, funded by Department of Science and Technology, for highly motivated students pursuing Basic Sciences
- **1<sup>st</sup> position in Mimamsa (2014), a Multidisciplinary Inter-College Science Olympiad**
  - MIMAMSA is an inter college science quiz conducted by IISER Pune. It's the most conceptually challenging competition at undergraduate level in India.
- **Maths, Physics and Chemistry Olympiads (2011-2013)**
  - Among the top 99 percentile

## Research Projects

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- **Bio-Economic modelling of fisheries** **UC Davis**  
*Authors: **Appilineni Kushal**, Michael Springborn, Fernanda Valdovinos* Oct 2021 – April 2024
  - Developed a novel bio-economic fishery model, taking 3 new factors previously not considered
  - Used super computing clusters to generate over 100 GBs of ecological networks data
  - Analyzed time series of 400 fishery networks using statistical and interpolation methods
  - Performed policy optimization over 10 ecological and economic factors for marine ecosystems
  - Created public GitHub repository for code sharing and accessibility to our research
  - Wrote a scientific paper highlighting our contributions and presented our work in ecology conferences.
- **Modelling pest regulation in forests** **UC Davis**  
*Authors: **Appilineni Kushal**, Alan Hastings* June 2020 – present
  - Developed spatial model for pests and their natural enemy, integrating previously unconsidered real-world spatial variations, used Monte Carlo methods to generate over 20GBs time series data
  - Analyzed those time series data using tools from dynamical systems, emphasizing sensitivity to small spatial variations and modelling choices
  - Used image processing tools to visualize and uncover new spatial patterns, previously unknown
  - Wrote two scientific papers and presented our work in both physics and ecology conferences.
- **Using machine learning models to analyze forest fires** **UC Davis**  
*Authors: **Appilineni Kushal*** March 2021 – June 2021
  - Examined accuracy of diverse classifiers (K-means, SVM, Gradient Boosting, Neural Networks), in differentiating between natural and human-caused fire incidents.
  - Highlighted the use of ML classifiers in identifying causes of unknown forest fires across US.
  - Used clustering algorithms to detect new outliers in forest data.
- **Big data and adaptive complex systems** **IMSc, Chennai**  
*Authors: V Sasidevan, **Appilineni Kushal**, Sitabhra Sinha* May 2015–July 2018
  - Used a game theory model to show large information access by agents doesn't necessarily ensures success in acquiring resources
  - Used information theory to show the critical limit beyond which accessing higher amounts of data could be detrimental to agents success
  - Wrote 2 scientific papers highlighting contributions of our work.
- **Modelling desertification of grassland ecosystems** <sup>2</sup>**IISc, Bangalore**  
*Authors: S. Majumdar, S. Sankaran, **Appilineni Kushal**, Vishwesh Guttal* May 2016– May 2017
  - Adapted a directed percolation model from physics to model grassland ecosystem
  - Showed the existence of tipping points with increasing temperature using Monte Carlo simulations
  - Used Fokker-Plank equations to show environmental fluctuations could trigger desertification in small grassland ecosystems
  - Wrote 1 scientific papers highlighting contributions of our work.
- **Modelling genetic mutations in non-motile bacterial populations** <sup>3</sup>**NCBS, Bangalore**  
*Author: **Appilineni Kushal**, Shashi Thutupalli* June 2017–June 2019
  - Developed a model of long range dispersal (by an agent) in mutating non-motile bacterial populations
  - Showed the decrease in mutations frequencies as dispersal was increased, using image processing and statistical tools.
  - Gave a public talk to other scientists and peers highlighting results from our work.

<sup>1</sup>**IMSc** - Institute of Mathematical Sciences, Chennai, India

<sup>2</sup>**IISc** - Indian Institute of Science, Bengaluru, India

<sup>3</sup>**NCBS** - National Centre for Biological Sciences, Bengaluru, India

## Conference Talks

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- Contributing a talk at **Ecological Society of America (ESA) Annual Meeting 2024**, Long Beach.
- Contributed talk at **Ecological Society of America (ESA) Annual Meeting 2023**, Portland.
- Contributed talk at **American Physical Society (APS) March Meeting 2023**, Las Vegas.
- Contributed talk at **American Physical Society (APS) March Meeting 2022**, Chicago.

## Work Experience and Education

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- **University of California, Davis** **Davis, California**  
*Teaching Assistant, Department of Mathematics and Statistics* *2019 - current*
- **National Center for Biological Sciences** **Bangalore, India**  
*Junior Research Fellow, Simon's Center for the study of Living Machines* *2018–2019*
- **Indian Institute of Science** **Bangalore, India**  
*Bachelors of Science and Masters of Science (BS-MS) dual degree, Physics Major* *2013–2018*

## Teaching and Supervising

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- **Specialized math courses**
  - BIM 105 - Probability and Data Science for Biomedical Engineers (Fall 2022)
  - MAT 27A - Linear Algebra with applications to Biology (Winter 2024 and 2022)
  - MAT 124 - Mathematical Biology of Infectious Diseases (Spring 2022)
    - Supervised 9 student led projects modelling infectious diseases like HIV, Measels, H1N1 etc.
    - Advised on the accuracy and validity of mathematical and computational analyses in these projects.
- **Mathematics courses**
  - MAT 22B - Associate Instructor - Differential equations - Summer 2020, 2021, 2022 and 2024

## Referees

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- **Fernanda Valdovinos** - Department of Environmental Science and Policy, UC Davis  
Email ID - [fvaldovinos@ucdavis.edu](mailto:fvaldovinos@ucdavis.edu)
- **Alan Hastings** - Department of Environmental Science and Policy, UC Davis  
Email ID - [amhastings@ucdavis.edu](mailto:amhastings@ucdavis.edu)
- **Michael Springborn** - Department of Environmental Science and Policy, UC Davis  
Email ID - [mspringborn@ucdavis.edu](mailto:mspringborn@ucdavis.edu)
- **Javier Arsuaga** - Department of Mathematics and Statistics, UC Davis  
Email ID - [jarsuaga@ucdavis.edu](mailto:jarsuaga@ucdavis.edu)
- **Vishwesh Guttal** - Centre for Ecological Sciences, Indian Institute of Science (IISc), Bangalore  
Email ID - [guttal@iisc.ac.in](mailto:guttal@iisc.ac.in)
- **Sitabhra Sinha** - Department of Physics, Institute of Mathematical Sciences (IMSc), Chennai  
Email ID - [sitabhra@imsc.res.in](mailto:sitabhra@imsc.res.in)
- **Shashi Thutupalli** - Simons Centre for the Study of Living Machines, National Centre for Biological Sciences (NCBS), Bangalore  
Email ID - [shashi@ncbs.res.in](mailto:shashi@ncbs.res.in)

\*click on the name to navigate to their webpage