

# Machine Learning for Public Policy

## UAPP 667-011

Prof. Gregory Dobler

Email: [gdobler@udel.edu](mailto:gdobler@udel.edu)

Course website: <http://mlpp21.slack.com>

Office hours: **TBD**

---

### Date and Time

Spring 2021

Times: Tue/Thu, 5:00pm – 6:15pm

Location: All class meetings and office hours will be held via Zoom

### Course Description

Data-driven policy decisions are becoming an increasingly important aspect of civic operations. From infrastructure assessment to environmental regulations to public safety, data exploration has opened up new avenues for enabling decision makers to enhance the public welfare and quality of life. However, the data themselves do not tell the story and do not drive the decision making process. Rather, it is the analysis of that data by inference through the application of computational algorithms known as machine learning (ML; including artificial intelligence) that enable their use. This course will survey some of the most common ML and analysis techniques used in the analysis of data (from academic, public, and private sectors) that impacts policy and decision making. It will focus on both qualitative and quantitative understanding of these techniques as well as appropriate use of analysis methods including uncertainties, model bias, and ethical considerations.

### Course Goals

This course will:

- provide an overview of ML and data science (DS) concepts important for decision making in policy determinations
- introduce students to a set of tools for acquiring and analyzing public/private/academic data that can be used to assess the impacts of policy decisions
- present topics that are foundationally important to data use in society such as the open data and open source ethos, reproducibility, (un-)certainty and bias, privacy, and data ethics.

Upon successful completion the student will be able to:

- assess the validity and uncertainty of ML and DS analysis outcomes for policy determinations
- appropriately apply ML models and DS techniques to real-world problems
- present the results of policy-focused, data-driven analysis through data visualizations.

## **Course Format**

For most weeks, the Tuesday session will consist of a lecture-style format that introduces new ML and DS concepts, while the Thursday session is an interactive application of those techniques to a data problem that is related to policy decision making. The applications sessions will be hands-on with students directly analyzing and applying ML and DS techniques to data using the Python language (expertise or previous exposure to Python is **not** required).

## **Attendance Policy**

All class meetings will be held synchronously via Zoom. A link to the call will be posted to the mlpp21.slack.com #general channel shortly beforehand and attendance is mandatory. The purpose of this policy is to maintain engagement in the class despite the online format with the emphasis that *my driving goal is that each student is able to learn the material, be engaged in the discussions, and gain familiarity with machine learning in a public policy context so that their future work is positively impacted*. If you have concerns about internet availability or bandwidth issues, please get in touch with me directly as soon as possible. Additionally, if you have any suggestions for improving your learning experience in this course, please do let me know.

## **Assignments and Late Submissions**

Weekly assignments (Colaboratory notebooks) will be distributed through UD's Google Drive infrastructure with due dates and times clearly indicated. Students should make their own copy of the assignment notebooks, complete the assignment, and share (again, via Google Drive) their completed copy of the notebook with me before the due date/time. Notebooks submitted up to 72 hours after the due date/time will accrue a late penalty of 15%. Beyond 72 hours, notebooks can be submitted through the final day of classes with a late penalty of 50%.

## **Recommended Prerequisites**

UAPP 691 or equivalent; basic statistics; experience working with data through an analysis platform (Python, R, SAS, SPSS, etc).

## **Recommended Materials**

There will be no textbook, slides and handouts from class will constitute the bulk of the material. Reading will be assigned from relevant articles and papers, and resources will be made available through the course Slack workspace.

## **Performance Evaluation**

Class participation and engagement : 15%

Weekly assignments : 25%

Midterm paper and presentation : 25%

Final project and presentation : 35%

## **Weekly Schedule**

Week 1      Machine Learning, Data Science, and Data Mining overview.  
                 Dealing with Data: introduction to analysis tools, data types, data use cases.

- Use case: Citi Bike Sharing
- Week 2 Public Sector Data and the Open Data ecosystem: data availability and access.  
Basic Statistics and (multi-)Linear Regression review.  
Use case: Sea Level Rise
- Week 3 Time Series Data and trends.  
Introduction to data features and feature comparison.  
Clustering methods: K-Means, DBSCAN, Agglomerative  
Use case: Economic Trends in Cities
- Week 4 Introduction to Geospatial Data.  
Interpolation and Kriging.  
Use case: Mapping Gentrification in Urban Areas
- Week 5 Data Ethics Part 1: misuse of data, anonymization vs de-identification, personally identifiable information, equity, model uncertainties.  
Use Case: Public Health Records
- Week 6 Getting your hands on data: URL handling, munging, cleaning, missing data, reproducibility
- Week 7 **Midterm Paper and Presentation**
- Week 8 Decision Trees and Random Forest.  
Regression Trees and Boosting.  
Use case: Predicting Energy Consumption and Use
- Week 9 Basic of model evaluation: errors and noise, ROC, precision and recall, covariance, bias
- Week 10 Neural Networks and Artificial Intelligence.  
Blackbox vs Interpretable Models.  
Use case: Social Media and Public Sentiment
- Week 11 Convolutional Neural Networks and Deep Learning.  
Introduction to Big Data analytics tools and scope.  
Use case: Transportation in Smart Cities
- Week 12 Data Ethics Part 2: feature engineering, training set construction, cyber-security and access rules, data sharing, sensing platforms
- Week 13 **Final Project and Presentation**

## **Course and UD Policies**

### *Attendance*

Absences on religious holidays listed in university calendars is recognized as an excused absence. Nevertheless, students are urged to remind the instructor of their intention to be absent on a particular upcoming holiday. Absences on religious holidays not listed in university calendars, as well as absences due to athletic participation or other extracurricular activities in which students are official representatives of the university, shall be recognized as excused absences when the student informs the instructor in writing during the first two weeks of the semester of these planned absences for the semester.

### *Academic Integrity*

Please familiarize yourself with UD policies regarding academic dishonesty. To falsify the results of one's research, to steal the words or ideas of another, to cheat on an assignment, to re-submit the same assignment for different classes, or to allow or assist another to commit these acts corrupts the educational process. Students are expected to do their own work and neither give nor receive unauthorized assistance. Complete details of the university's academic integrity policies and procedures can be found at <http://www1.udel.edu/studentconduct/policyref.html> Office of Student Conduct, 218 Hullahen Hall, (302) 831-2117. E-mail: [student-conduct@udel.edu](mailto:student-conduct@udel.edu)

### *Harassment and Discrimination*

The University of Delaware works to promote an academic and work environment that is free from all forms of discrimination, including harassment. As a member of the community, your rights, resource and responsibilities are reflected in the non-discrimination and sexual misconduct policies. Please familiarize yourself with these policies at [www.udel.edu/oei](http://www.udel.edu/oei) . You can report any concerns to the University's Office of Equity & Inclusion, at 305 Hullahen Hall, (302) 831-8063 or you can report anonymously through UD Police (302) 831-2222 or the EthicsPoint Compliance Hotline at [www1.udel.edu/compliance](http://www1.udel.edu/compliance). You can also report any violation of UD policy on harassment, discrimination, or abuse of any person at this site: [sites.udel.edu/sexualmisconduct/how-to-report/](http://sites.udel.edu/sexualmisconduct/how-to-report/)

### *Faculty Statement on Disclosures of Instances of Sexual Misconduct*

If, at any time during this course, I happen to be made aware that a student may have been the victim of sexual misconduct (including sexual harassment, sexual violence, domestic/dating violence, or stalking), I am obligated to inform the university's Title IX Coordinator. The university needs to know information about such incidents in order to offer resources to victims and to ensure a safe campus environment for everyone. The Title IX Coordinator will decide if the incident should be examined further. If such a situation is disclosed to me in class, in a paper assignment, or in office hours, I promise to protect your privacy--I will not disclose the incident to anyone but the Title IX Coordinator. For more information on Sexual Misconduct policies, where to get help, and how to reporting information, please refer to [www.udel.edu/sexualmisconduct](http://www.udel.edu/sexualmisconduct). At UD, we provide 24-hour crisis assistance and victim advocacy and counseling. Contact 302-831-1001, UD Helpline 24/7/365, to get in touch with a sexual offense support advocate.

For information on various places you can turn for help, more information on Sexual Misconduct policies, where to get help, and reporting information please refer to [www.udel.edu/sexualmisconduct](http://www.udel.edu/sexualmisconduct)

### *Inclusion of Diverse Learning Needs*

Any student who thinks he/she may need an accommodation based on a disability should contact the Office of Disability Support Services (DSS) office as soon as possible. The DSS office is located at 240 Academy Street, Alison Hall Suite 130, Phone: 302-831-4643, fax: 302-831-3261, DSS website ([www.udel.edu/DSS/](http://www.udel.edu/DSS/)). You may contact DSS at [dsoffice@udel.edu](mailto:dsoffice@udel.edu)

### *Non-Discrimination*

The University of Delaware does not discriminate against any person on the basis of race, color, national origin, sex, gender identity or expression, sexual orientation, genetic information, marital status, disability, religion, age, veteran status or any other characteristic protected by applicable law in its employment, educational programs and activities, admissions policies, and scholarship and loan programs as required by Title IX of the Educational Amendments of 1972, the Americans with Disabilities Act of 1990, Section 504 of the Rehabilitation Act of 1973, Title VII of the Civil Rights Act of 1964, and other applicable statutes and University policies. The University of Delaware also prohibits unlawful harassment including sexual harassment and sexual violence.

For inquiries or complaints related to non-discrimination policies, please contact:

Interim Director, Institutional Equity & Title IX Coordinator - Fatimah Stone  
[titleixcoordinator@udel.edu](mailto:titleixcoordinator@udel.edu), 305 Hullihen Hall Newark, DE 19716 (302) 831-8063

For complaints related to Section 504 of the Rehabilitation Act of 1973 and/or the Americans with Disabilities Act, please contact: Director, Office of Disability Support Services, Anne L. Jannarone, M.Ed., Ed.S. - [ajannaro@udel.edu](mailto:ajannaro@udel.edu) Alison Hall, Suite 130, Newark, DE 19716 (302) 831-4643 OR contact the U.S. Department of Education - Office for Civil Rights ([wdcrobcolp01.ed.gov/CFAPPS/OCR/contactus.cfm](http://wdcrobcolp01.ed.gov/CFAPPS/OCR/contactus.cfm))