ECON-UN 4999 — Senior Honors Thesis Seminar

Workshop 1: Foundations of programming for economics research

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Introduction

About me

- Grew up in Manila, Jakarta, Ho Chi Minh City
- Undergrad in New York and London
- Academia:
    - Research assistant at Stanford's Earth System Science department
    - Economics master's at Oxford
    - Economics PhD at Columbia
    - Happy to chat about any of these experiences in office hours
- Teaching:
    - Econometrics (x4)
    - Intermediate micro (x2)
    - The global economy

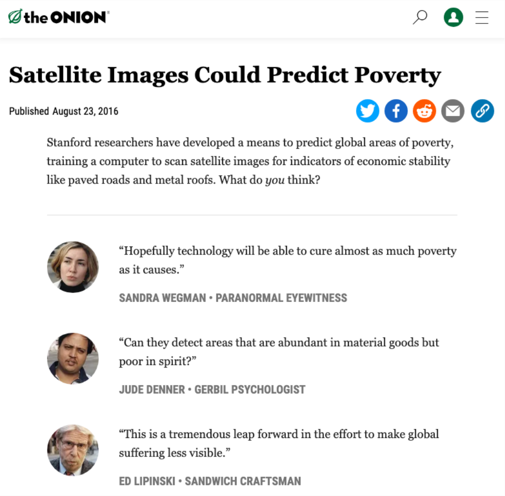
Research: development, environmental economics, political economy

Past work:

1. Using satellite imagery to locate poverty
2. Quantifying benefits of mitigating global warming

Dissertation:

1. Climate change and inequality
2. Weather shocks and political transitions
3. Cultural transmission of gendered violence and norms



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Satellite Images Could Predict Poverty

Published August 23, 2016

Stanford researchers have developed a means to predict global areas of poverty, training a computer to scan satellite images for indicators of economic stability like paved roads and metal roofs. What do *you* think?

"Hopefully technology will be able to cure almost as much poverty as it causes."

SANDRA WEGMAN • PARANORMAL EYEWITNESS

"Can they detect areas that are abundant in material goods but poor in spirit?"

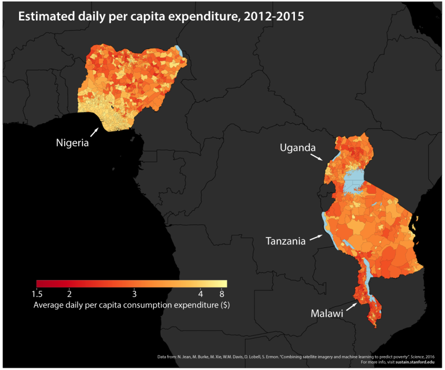
JUDE DENNER • GERBIL PSYCHOLOGIST

"This is a tremendous leap forward in the effort to make global suffering less visible."

ED LIPINSKI • SANDWICH CRAFTSMAN

Learning how to program: my experience

1. Quantitative topics courses
    - Macro-finance with Matlab
    - Time series econometrics with R
    - Quantitative economics and dynamic programming with Python
    - Part-time RA using Python
2. Apply to a bunch of research positions
3. Lie about how good I am at R
4. Move to the other side of the country
5. Spend eight hours a day Googling
6. Get published



These two workshops are for making you as self-sufficient as possible

Goal of these workshops

- Overview the most common and useful data operations
- Instill best practices for responsible and understandable data work
- Get a sense of what programming can do
- Most importantly, get out of your own way

Not the goal:

- Becoming fluent in a programming language
- Memorizing commands
- An exhaustive tutorial of the commands your project will need

Me as a resource

- Office hours
  - Rest of October (2 hours per week)
    Friday: 2:30-4:30 at **Hamilton 408**
  - Starting November (6 hours per week)
    Thursday: 1:15-3:15pm by Zoom
    Friday: 2:30-6:30pm at **IAB 1102**
- Reach out but no guarantees
  - Some flexibility if hours don't work
  - Emails for small things not worth a meeting
  - Recommendations for external resources or references
- Keeping running notes on what people are working on
- General resources periodically updated on my website: wmadavis.com/teaching

Office hours: before the meeting

Go in with a general plan:

1. Book two slots if you need (15 minutes go by fast!)
2. What is the problem/question?
3. Is there anything you want to show me?
4. What do you want to come away from our meeting with?

Anything for me to know or look at in advance?

- For example
  - Important context
  - What kind of problem/method/data, paper you're borrowing from?
  - What software or programming language you're using
- There are lots of things I don't know but can prepare for
- If so, provide by Calendly or email ahead of meeting

Plan for today

1. Reviewing the essentials of data analysis
2. Organization 1: Anatomy of a script

Reviewing the essentials of data analysis

Statistical software and programming languages

$tata: Very efficient at statistical operations on a single dataset

- **Stata**
  reg y x, robust
- **Compared to R**:
  library(fixest)
  model <- feols(y ∼ x, data = dataset, se = 'robust')
  etable(model)

"Object-oriented" programming languages (e.g., R, Python, Julia)

- Environment can contain any number of accessible 'objects': words, scalars, vectors, vectors of words, arrays, matrices, tables, graphs, models, estimates, functions, lists, lists of objects, …
- General purpose: multiple datasets, spatial data, text data, online data, machine learning, parallelized computing, creating documents, creating websites…

The basics of data processing: see R Notebook 01

1. Loading data
2. Summarizing data
3. Basic data transformations
4. Reshaping data
5. Statements, conditions, and loops

Organization 1: Anatomy of a script

First determine the purpose of your script and what you want it to do

- Working backwards
    - Outputs: what should you end up with?
    - Inputs: what data/objects/functions/packages are strictly required to produce them? Typically, these are all loaded at the top of a script in what's called the preamble
- The task of programming is to bridge the two as clearly and efficiently as possible and organize/comment on your script accordingly
- Pseudocode:
    - Break down the process from input to output into intuitive and discrete tasks
    - Describe what the task is in plain English
    - Translate that into real code and keep the plain English as a comment

Scripting: tips and pitfalls

- Make sure commands are written in sequence
    - If you are saving regression estimates in line 30, the command to run the regression should be somewhere between lines 1 and 29
    - Use the console for taste tests and experimenting and the script/do editor for recording your recipe
    - Beginners make the mistake of using scripts like scratch paper and risk being unable to retrace their steps
- Make sure the script is self-contained
    - Conditional on all the inputs having been generated or installed, the script should be able to run successfully even if you were to run it in a fresh Stata/R session

Scripting: tips and pitfalls

- Don’t do too many things in one script
    - Messy and hard to read
    - Easier to make mistakes
    - Harder to locate and fix mistakes
- Don’t do too different things in one script
    - For example, don’t estimate regressions in the same script that you’re processing the data
    - Instead, save your processed data at the ends of your data processing script(s) and load that processed data at the start of your analysis script(s)
    - More on this when we get to project-oriented workflows

Next week

1. Project-oriented workflows
2. From estimation to communication: tables and data visualization
3. Synthesizing example: following a project workflow from start to finish
4. More specific and advanced applications