ECOG 315 / ECON 181, Summer 2025
Advanced Research Methods and Statistical Programming
Week 1 Lecture Slides

Matthew N. White

Howard University

May 30, 2025

Who Are These Guys? Matt White

- Instructor of record: Matthew N. White (Matt)
- Email: `mnwhite@gmail.com`; Cell: (603) 566 0413
- I will be here **most** weeks; others will be here **sometimes**
- Previously at University of Delaware, now with Econ-ARK
- Primary interests: health economics, heterogeneous agents macro

Who Are These Guys? Matt White

Who Are These Guys? Chris Carroll

- Most senior instructor: Christopher D. Carroll (Chris)
- Email: ccarroll@jhu.edu
- Professor at Johns Hopkins economics department
- World expert in consumption-saving theory and empirics
- Has advised many PhDs, taught research skills course

Who Are These Guys? Chris Carroll

Who Are These Guys? Alan Lujan

- Content-producing instructor: Alan E. Lujan-Solis (Alan)
- Email: `alujan@jhu.edu`
- Program coordinator and lecturer at JHU Advanced Academic Programs
- Primary interests: computational methods for economics
- Will make and share **asynchronous** Zoom videos

Who Are These Guys? Alan Lujan

Who Are These Guys? Econ-ARK

- All of your instructors work for or with Econ-ARK
- Non-profit org that makes open source software for economists
- And tools/structures for archiving research projects
- Website: `http://www.econ-ark.org`
- We didn't expect to be teaching the course, please bear with us!

Course Communication Channels

- We don't have access to Canvas or class list (yet)
- GitHub repository: `https://github.com/econ-ark/aeasp.2025`
- The repo is "live" and edited frequently; you will submit via pull requests

Course Communication Channels

- We don't have access to Canvas or class list (yet)
- GitHub repository: `https://github.com/econ-ark/aeasp.2025`
- The repo is "live" and edited frequently; you will submit via pull requests
- If you have questions, please email us, especially Matt
- If it's something of concern to others, open an issue on GitHub
- Each team will meet weekly with their advisor, scheduled independently

Course Communication Channels

- We don't have access to Canvas or class list (yet)
- GitHub repository: `https://github.com/econ-ark/aeasp.2025`
- The repo is "live" and edited frequently; you will submit via pull requests
- If you have questions, please email us, especially Matt
- If it's something of concern to others, open an issue on GitHub
- Each team will meet weekly with their advisor, scheduled independently
- Matt and Alan use Discord; do you want to use Discord for the course?

Big Picture: How to Be an Economist

- You will learn a **lot** in an economics PhD program
- Lots of economics, lots of math, lots of econometrics

Big Picture: How to Be an Economist

- You will learn a **lot** in an economics PhD program
- Lots of economics, lots of math, lots of econometrics
- How to **do** research: asking question, lit review, forming strategy, iterating
- How to **communicate**: academic writing, presentations/slides, selling yourself

Big Picture: How to Be an Economist

- You will learn a **lot** in an economics PhD program
- Lots of economics, lots of math, lots of econometrics
- How to **do** research: asking question, lit review, forming strategy, iterating
- How to **communicate**: academic writing, presentations/slides, selling yourself
- There are tools to help you with those things; often not explicitly taught
- Being familiar with the tools of the trade is part of being an academic / economist

What Are We Doing Here? Course Overview

- We are going to help you learn to be an economist
- In lectures: teaching you about tools used in research and collaboration
- In lectures: advice for executing research steps and applying those tools

What Are We Doing Here? Course Overview

- We are going to help you learn to be an economist
- In lectures: teaching you about tools used in research and collaboration
- In lectures: advice for executing research steps and applying those tools
- In lectures: presenting your research progress and getting feedback

What Are We Doing Here? Course Overview

- We are going to help you learn to be an economist
- In lectures: teaching you about tools used in research and collaboration
- In lectures: advice for executing research steps and applying those tools
- In lectures: presenting your research progress and getting feedback
- Asynchronous Zoom: specific applied econometrics and computational methods

What Are We Doing Here? Course Overview

- We are going to help you learn to be an economist
- In lectures: teaching you about tools used in research and collaboration
- In lectures: advice for executing research steps and applying those tools
- In lectures: presenting your research progress and getting feedback
- Asynchronous Zoom: specific applied econometrics and computational methods
- Adviser meetings: ongoing personal discussions of your research progress

What Are We Doing Here? Course Overview

- We are going to help you learn to be an economist
- In lectures: teaching you about tools used in research and collaboration
- In lectures: advice for executing research steps and applying those tools
- In lectures: presenting your research progress and getting feedback
- Asynchronous Zoom: specific applied econometrics and computational methods
- Adviser meetings: ongoing personal discussions of your research progress
- Grading: qualitative hand-waving

The Platinum Rule

- Google is your friend; the internet is full of lies, but use it anyway
- Someone else almost surely had the same Q you did, and got an answer

The Platinum Rule

- Google is your friend; the internet is full of lies, but use it anyway
- Someone else almost surely had the same Q you did, and got an answer
- We will also show you how to **responsibly** use AI in your work

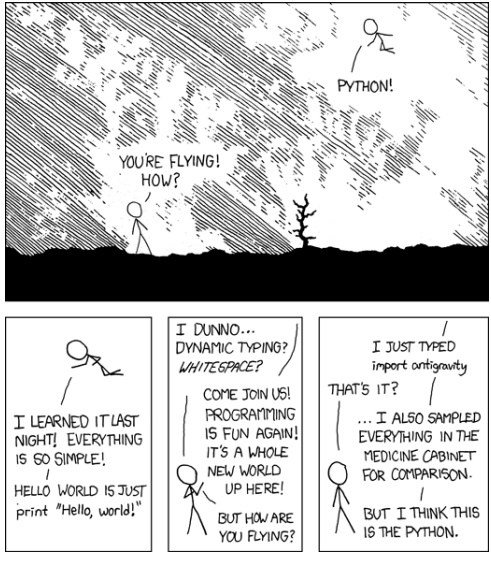
The Platinum Rule

- Google is your friend; the internet is full of lies, but use it anyway
- Someone else almost surely had the same Q you did, and got an answer
- We will also show you how to **responsibly** use AI in your work
- WRONG: "Please write me a 1000 word essay about X, and provide citations."
- RIGHT: "I think these two paragraphs are too wordy and repetitive. Please help me shorten and clarify them."

Agenda for Week 1

- ~~Personal and course introductions~~
- Installing Anaconda distribution of Python
- Setting up GitHub account and GitHub Desktop
- Interacting with course repo via GitHub
- Basics of `conda` environments
- Basics of Python / IDEs / Jupyter notebooks

Why Python?


PYTHON!
YOU'RE FLYING! HOW?
I LEARNED IT LAST NIGHT! EVERYTHING IS SO SIMPLE!
HELLO WORLD IS JUST print "Hello, world!"
I DUNNO... DYNAMIC TYPING? WHITESPACE?
COME JOIN US! PROGRAMMING IS FUN AGAIN! IT'S A WHOLE NEW WORLD UP HERE!
BUT HOW ARE YOU FLYING?
I JUST TYPED import antigravity
THAT'S IT?
... I ALSO SAMPLED EVERYTHING IN THE MEDICINE CABINET FOR COMPARISON.
BUT I THINK THIS IS THE PYTHON.

Why Python?

- High level language: closer to human language than machine code
- Well documented and supported: **many** packages available via PyPI

Why Python?

- High level language: closer to human language than machine code
- Well documented and supported: **many** packages available via PyPI
- Widely used in scientific computing
- Completely free and open source

Why Python?

- High level language: closer to human language than machine code
- Well documented and supported: **many** packages available via PyPI
- Widely used in scientific computing
- Completely free and open source
- Easy to program and run native Python code; human time is valuable
- Easy to extend and link to other languages: acceleration via `jit`

Why Python?

- High level language: closer to human language than machine code
- Well documented and supported: **many** packages available via PyPI
- Widely used in scientific computing
- Completely free and open source
- Easy to program and run native Python code; human time is valuable
- Easy to extend and link to other languages: acceleration via `jit`
- Not the best at anything, but good enough at everything

Anaconda Distribution

- Python comes in **distributions**: specific implementations with packages
- Anaconda: widely used distribution for scientific computing

Anaconda Distribution

- Python comes in **distributions**: specific implementations with packages
- Anaconda: widely used distribution for scientific computing
- Automatically includes all of the most commonly used packages for scientific work
- Has its own virtual environment and package manager, `conda`

Anaconda Distribution

- Python comes in **distributions**: specific implementations with packages
- Anaconda: widely used distribution for scientific computing
- Automatically includes all of the most commonly used packages for scientific work
- Has its own virtual environment and package manager, `conda`
- Also comes with a pretty nice interactive development environment (IDE), Spyder
- Spyder is set up for IPython: better graphical presentation

Installing Anaconda

- Go to `https://www.anaconda.com/download`
- Submit your email or click "skip registration"
- Select the distribution installer for your OS
- You probably want the graphical installer if it's an option
- Download it, then install Anaconda; this will take a bit

Collaboration and Version Control with `git`

- You have done group work; probably shared docs by email or Dropbox
- Academic research is a really big group project: so many files

Collaboration and Version Control with `git`

- You have done group work; probably shared docs by email or Dropbox
- Academic research is a really big group project: so many files
- Multiple people working on same file at the same time: oh no!
- Realize in November that you need some file how it looked back in May

Collaboration and Version Control with `git`

- You have done group work; probably shared docs by email or Dropbox
- Academic research is a really big group project: so many files
- Multiple people working on same file at the same time: oh no!
- Realize in November that you need some file how it looked back in May
- Academic / programmer solution: version control via `git`
- Track **entire** history of file changes, easy to revert to prior version

Collaboration and Version Control with `git`

- You have done group work; probably shared docs by email or Dropbox
- Academic research is a really big group project: so many files
- Multiple people working on same file at the same time: oh no!
- Realize in November that you need some file how it looked back in May
- Academic / programmer solution: version control via `git`
- Track **entire** history of file changes, easy to revert to prior version
- Make "branches" from main, can merge separate work paths via pull requests
- Work on files locally, but long term archived on a remote server

Making `git` Easier: GitHub

- `git` was created by Linus Torvalds, the Linux guy; it's a command line tool
- GitHub is a website and desktop app that provides an easier interface for `git`
- You can use command line `git`, but I will show you GitHub Desktop

Making `git` Easier: GitHub

- `git` was created by Linus Torvalds, the Linux guy; it's a command line tool
- GitHub is a website and desktop app that provides an easier interface for `git`
- You can use command line `git`, but I will show you GitHub Desktop
- Go to `https://github.com`, enter your email address and sign up
- Everything you need for this course is on free tier, but you can pay for more

Making `git` Easier: GitHub

- `git` was created by Linus Torvalds, the Linux guy; it's a command line tool
- GitHub is a website and desktop app that provides an easier interface for `git`
- You can use command line `git`, but I will show you GitHub Desktop
- Go to `https://github.com`, enter your email address and sign up
- Everything you need for this course is on free tier, but you can pay for more
- Next: Go to `https://github.com/apps/desktop` and install GitHub Desktop
- Then open it and sign in to your GitHub account; only have to do this once

What the Fork is a Repository?

- A collection of files in `git` is called a repository (repo)
  - All of your work for one academic project would be a repository
  - The (non-Canvas) course website is a GitHub repository
  - The development of a new Python package would happen in a repo

What the Fork is a Repository?

- A collection of files in `git` is called a repository (repo)
  - All of your work for one academic project would be a repository
  - The (non-Canvas) course website is a GitHub repository
  - The development of a new Python package would happen in a repo
- GitHub repos can be **public** and available to everyone who finds it
- Or can be **private** and only accessible to invited collaborators

What the Fork is a Repository?

- A collection of files in `git` is called a repository (repo)
  - All of your work for one academic project would be a repository
  - The (non-Canvas) course website is a GitHub repository
  - The development of a new Python package would happen in a repo
- GitHub repos can be **public** and available to everyone who finds it
- Or can be **private** and only accessible to invited collaborators
- A repo can be **forked**, making a new personal copy– it can be private!
- You can issue a **pull request** (PR) to send changes from your fork back to the "upstream" repo

Forking the Course Repository

- Each of you will make a personal fork of the course repository
- You will submit assignments (etc) by issuing a PR back to the upstream repo
- Go to course website: `https://github.com/econ-ark/aeasp.2025`
- Click the menu arrow near "Fork" in top right, select "Create a new fork"
- Default options should be fine; click green "Create" button

Cloning Your Fork to Local Machine

- Repos (and forks) actually live on the remote GitHub server
- You must **clone** them to your computer to work with files
- Creates a local working copy of the repo (or your fork)
- Open GitHub Desktop and:
  1. Click "Repository" button in top left
  2. Then "Add" and "Clone repository..."
  3. Select `YourHandle/aeasp.2025`, probably only option
  4. Choose a local directory to put it in
- All of the course repo files are now on your computer!

Where's the Remote? Making Commits

- Changes that you make to your local clone don't automatically go to remote
- Need to **commit** them: "put a pin" in changes, with (label and comments)

Where's the Remote? Making Commits

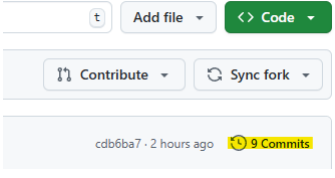
- Changes that you make to your local clone don't automatically go to remote
- Need to **commit** them: "put a pin" in changes, with (label and comments)
- Easiest to show by example: open up `/materials/setup/Survey.txt`
- Read the instructions, then fill out the short survey below
- Save file as instructed in step (3) of the survey document; my survey is there

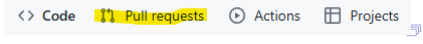
Where's the Remote? Making Commits

- Changes that you make to your local clone don't automatically go to remote
- Need to **commit** them: "put a pin" in changes, with (label and comments)
- Easiest to show by example: open up `/materials/setup/Survey.txt`
- Read the instructions, then fill out the short survey below
- Save file as instructed in step (3) of the survey document; my survey is there
- In GitHub Desktop, click on "Changes"; name your commit, comments optional
- Click "commit to main", then click "push to remote" at the top
- Pushing to remote is what actually shares your local work with the server

Where's the Remote? Making Pull Requests

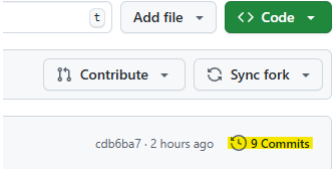
- Navigate on `github.com` to your fork of the course repo
- Click on the "1 commits" button; the commit you just made should be there!

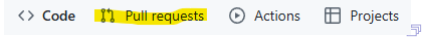




Where's the Remote? Making Pull Requests

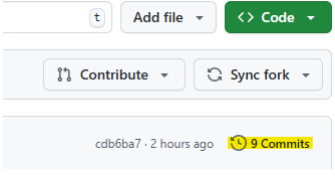
- Navigate on `github.com` to your fork of the course repo
- Click on the "1 commits" button; the commit you just made should be there!
- But I want your survey in the upstream course repo; need to make a **pull request**
- PR: Request to merge "downstream" work into "upstream" project

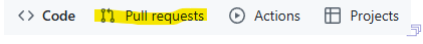




Where's the Remote? Making Pull Requests

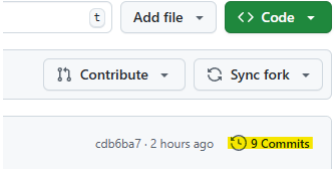
- Navigate on `github.com` to your fork of the course repo
- Click on the "1 commits" button; the commit you just made should be there!
- But I want your survey in the upstream course repo; need to make a **pull request**
- PR: Request to merge "downstream" work into "upstream" project
- At top left, click "Pull requests", then "New pull request"
- Ensure you're going from `YourHandle/aeasp.2025` to `Econ-ARK/aeasp.2025`
- Give a title and descriptive comments to your PR, then create/submit it

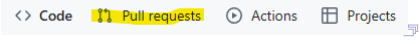




Where's the Remote? Making Pull Requests

- Navigate on `github.com` to your fork of the course repo
- Click on the "1 commits" button; the commit you just made should be there!
- But I want your survey in the upstream course repo; need to make a **pull request**
- PR: Request to merge "downstream" work into "upstream" project
- At top left, click "Pull requests", then "New pull request"
- Ensure you're going from `YourHandle/aeasp.2025` to `Econ-ARK/aeasp.2025`
- Give a title and descriptive comments to your PR, then create/submit it
- Then we can see your PR(s) on the course repo!





Anaconda and Virtual Environments

- There are a lot of Python packages, and you will have multiple projects
- Project A requires `CoolPackage` v0.8 or higher; Project B requires v0.7 or lower

Anaconda and Virtual Environments

- There are a lot of Python packages, and you will have multiple projects
- Project A requires `CoolPackage` v0.8 or higher; Project B requires v0.7 or lower
- Not a problem! `conda` can manage virtual Python environments
- Can have multiple collections/configurations of packages on your computer
- Manage each separately, switch between them with a single command

Anaconda and Virtual Environments

- There are a lot of Python packages, and you will have multiple projects
- Project A requires `CoolPackage` v0.8 or higher; Project B requires v0.7 or lower
- Not a problem! `conda` can manage virtual Python environments
- Can have multiple collections/configurations of packages on your computer
- Manage each separately, switch between them with a single command
- We probably won't use this much, but will install more packages
- Open up Anaconda Prompt (from Windows start menu, e.g.); terminal will open

Installing New Packages

- Example: installing `HARK`, Econ-ARK's primary software package
- In Anaconda prompt, type `pip install econ-ark`, accept

Installing New Packages

- Example: installing `HARK`, Econ-ARK's primary software package
- In Anaconda prompt, type `pip install econ-ark`, accept
- `pip` is the most common **package manager**, draws on Python Package Index
- `conda` is also a package manager, but **slightly** fussier

Installing New Packages

- Example: installing `HARK`, Econ-ARK's primary software package
- In Anaconda prompt, type `pip install econ-ark`, accept
- `pip` is the most common **package manager**, draws on Python Package Index
- `conda` is also a package manager, but **slightly** fussier
- `HARK` is now available for use on your computer
- But we won't be working with it yet

Actually Working with Python: Spyder

- You **can** write and edit Python code in any text editor
- And then run Python code from a command line with `python`

Actually Working with Python: Spyder

- You **can** write and edit Python code in any text editor
- And then run Python code from a command line with `python`
- Using an **interactive development environment** (IDE) just make things nicer
- Open up Spyder (e.g. from Windows start menu)

Actually Working with Python: Spyder

- You **can** write and edit Python code in any text editor
- And then run Python code from a command line with `python`
- Using an **interactive development environment** (IDE) just make things nicer
- Open up Spyder (e.g. from Windows start menu)
- There are a lot of panes; I close all of them except console and editor
- Can open them later from View menu, Panes option

Actually Working with Python: Spyder

- You **can** write and edit Python code in any text editor
- And then run Python code from a command line with `python`
- Using an **interactive development environment** (IDE) just make things nicer
- Open up Spyder (e.g. from Windows start menu)
- There are a lot of panes; I close all of them except console and editor
- Can open them later from View menu, Panes option
- Console pane: live Python environment, can run code commands one by one
- Editor pane: file editor; write scripts / programs, run with green arrow in toolbar

How to Learn Python

- We will give you hands-on instruction with Python, don't worry
- If you want to learn on your own, I recommend Kevin Sheppard's notes
- There's a copy in `/materials/setup/KevinSheppardPython.pdf`
- It's from four years ago; current Python versions are 3.10 to 3.13

How to Learn Python

- We will give you hands-on instruction with Python, don't worry
- If you want to learn on your own, I recommend Kevin Sheppard's notes
- There's a copy in `/materials/setup/KevinSheppardPython.pdf`
- It's from four years ago; current Python versions are 3.10 to 3.13
- Recommended reading order: Ch 1, 2, 4, 9, 10, 12, 18, 3, 6, 7, 5, 11, 15, 29
- Data operations: Ch 8, 16, 14, 17, 23
- More math stuff: Ch 19, 20, 21, 22
- General coding: Ch 13, 24, 25, 26, 28

Introduction to Jupyter Notebooks

- Communicating scientific ideas is sometimes aided by reader interaction
- **Jupyter notebooks** provide a way to integrate text, math, and code

Introduction to Jupyter Notebooks

- Communicating scientific ideas is sometimes aided by reader interaction
- **Jupyter notebooks** provide a way to integrate text, math, and code
- Go to `https://github.com/econ-ark/HARK` and fork our repo
- Then clone it to your personal computer

Introduction to Jupyter Notebooks

- Communicating scientific ideas is sometimes aided by reader interaction
- **Jupyter notebooks** provide a way to integrate text, math, and code
- Go to `https://github.com/econ-ark/HARK` and fork our repo
- Then clone it to your personal computer
- In Anaconda prompt, type `jupyter notebook`
- Navigate to your HARK clone directory, then go to `/examples/Gentle-Intro/`
- Open `Gentle-Intro-To-HARK.ipynb`

Introduction to Jupyter Notebooks

- Communicating scientific ideas is sometimes aided by reader interaction
- **Jupyter notebooks** provide a way to integrate text, math, and code
- Go to `https://github.com/econ-ark/HARK` and fork our repo
- Then clone it to your personal computer
- In Anaconda prompt, type `jupyter notebook`
- Navigate to your HARK clone directory, then go to `/examples/Gentle-Intro/`
- Open `Gentle-Intro-To-HARK.ipynb`
- Cells can be run individually with Shift+Enter