Econ 4850 Economic Analysis with Python

SPRING 2025
Department of Economics, Washington University in St. Louis

Instructor: Geoffrey Kam
Contact Information: g.kam@wustl.edu (Response time is within 24 hours.)
Office Hours: TBA
Office Location: 375 Seigle Hall

Course Details:

1.5 units
MW 5:30 – 6:50; March 3 – April 23, 2025
Course website: <Canvas course link to be inserted>
Prerequisite: Econ 1011, Econ 1021, and SDS 2000 (formerly Math 2200)
Additional requirement: students should bring a laptop to each class.
Adding/Dropping this course: Students cannot add/drop this course via WebStac after the first meeting. All requests for late add/drop must be directed to dottie@wustl.edu no later than NOON on Friday, March 7, 2025.

Course Description and Course Goals

- This half-semester course offers an introduction to scientific computing in Economics using Python. It is tailored for students with minimal, to no, programming experience, or those looking to start using Python. The course emphasizes hands-on learning, focusing on applying Python to scientific computing in Economics. Common computing methods and algorithms will be covered. The second focus of the course is to enable students to motivate economics problems by summarizing and visualizing patterns and moments from data. Through a hands-on approach, students will gain practical skills in utilizing Python libraries to enhance computational efficiency. Students must bring a laptop to the class.
- This course places less emphasis on economic theory and focuses more on mastering essential computational techniques for achieving quantitative results through practical applications. By the end of the course, students will be able to:
  - Extend their proficiency with some of the necessary computing skills to be a competent RA.
  - Write clean and efficient code for scientific computing in basic economic models.
  - Summarize and visualize data to support economic analysis and conduct rigorous computations with typical economic datasets.
  - Utilize widely-used Python libraries for economic applications.
  - Numerically solve simple economic models.

- Independently explore more advanced topics, such as Machine Learning, using the extensive open-source resources available.

Texts, Materials, and Supplies

- There is no required text for the course. Throughout the course, I will post small, but useful, resources for specific topics on Canvas. However, the following supplementary resources are recommended:
  - Quantecon: Quantecon offers open-source code and a series of lectures on economic modeling, providing a comprehensive resource for Python applications in economics. https://quantecon.org/
  - Introduction to Python for Econometrics, Statistics and Data Analysis: Fifth Edition, Kevin Sheppard. This provides complementary resources for students who are interested in looking for topics on data management and econometrics with Python. https://www.kevinsheppard.com/teaching/python/notes/#notes
  - Python Data Science Handbook, Jake VanderPlas: Another great resource in which the content overlaps with the first half of the course. A jupyter notebook version is also available. There is a section on machine learning for those who are interested in the topic. https://jakevdp.github.io/PythonDataScienceHandbook/

Grading

- Homework (55%): There will be five weekly assignments (each worth 11% of your total grade) that are designed to ensure students can replicate and extend classroom exercises. Assignments may include solving economic problems and should be treated as presentable reports, with clarity and organization being assessed. A basic rubric will be provided. Collaboration is encouraged, but each student must submit their own code and report.
  - Assignments will be submitted via Canvas, per the assignment directions.
  - No late submissions will be accepted.

- Class Attendance (12%):
  - Active participation in all classes is essential for hands-on learning. All classroom interactions are expected to remain civil, respectful, and supportive. Further policies and expectations are here. If you feel these standards are not being met, then you are encouraged to speak with the instructor during office hours, the department chair, or with your academic advisor.
  - Absences are only excused for medical emergencies with a doctor's note or in extreme personal circumstances. For the latter, please contact the instructor immediately. One unexcused absence is permitted without penalty.

- Final Project Presentation (33%): In groups of 2-3, students will deliver a 20-25 minute presentation during the final week, presenting an economic question driven by data. The presentation must include plots and quantitative analysis, with the research question being both compelling and addressable through data.

- Your group must have approval for your research question by the end of Week 5. The group will submit your research question via a Canvas assignment, and you will have approval (or directions for submitting a different research question) by the beginning of Week 6.
- Your group must be able to show basic data plots by the end of Week 6. The group will submit the basic data plots according to the directions in a Canvas-based assignment. Feedback indicating that the basic data plots are acceptable (or directions for how to improve them) will be provided by the beginning of Week 7.

Grading Scale & Policies.

97-100% A+; 93-96% A; 90-92% A-; 87-89% B+; 83-86% B; 80-82% B-; 77-79% C+; 73-76% C; 70-72% C-; 60-69% D; 0-60% F

Policy on Pass/Fail/Audit. Because this is a short course, students cannot change the grade option after the beginning of the course. Students may request to take the course P/F, and the deadline to do so is Friday, March 28, by 5PM. Students must email the Economics department Academic Coordinator to make this request: dottie@wustl.edu. Because this is a short course, o*nce the P/F grade option has been selected, it cannot be changed back to a letter-grade option.* Students completing this course with the P/F ("Pass/Fail") grade option must earn at least 70% of the total points in order to receive a passing grade. Students may not audit this course.

Policy on Generative AI usage. GenAI literacy is quickly becoming an important professional skill. As such, you are allowed to use GenAI tools in this class as long as you provide proper citations for those tools. In our first meeting, we'll spend class time discussing both the ethical implications and strategic considerations of using GenAI tools. Whenever you use an AI tool to assist you, you should cite it. Please follow the appropriate citation guidelines for citing GenAI tools in MLA, APA, Chicago, or Turabian Style. In addition, GenAI does not always produce responses appropriate for every assignment. You will likely need to use GenAI as a starting point, providing further revisions, expansions, or clarifications in order to meet assignment requirements. Ultimately, you are the final author of any compositions you put forth in this class and are accountable for their accuracy, credibility, and rhetorical usages.

Topics

Each of the "Topics," below, will take approximately one week to cover. Depending on the number of final project presentation groups, we may not cover Topic 6 completely. Please refer to Canvas for the most up-to-date information about course coverage. The calendar that follows describes our pacing through the course.

- Topic 1 - Week 1 (MW 3/3, 3/5): Introduction to Python Programming
  - Running Python Locally and Managing Libraries
  - Basic Python Syntax
  - (If time allows: Version Control with Github)

- Spring Break: March 9 – March 16
- Topic 2 – Week 2 (MW 3/17, 3/19: Basic Mathematical Operations
    - Basic Linear Algebra and Numpy
    - Closed-form OLS regression
    - (If time allows: Sympy)
- Topic 3 - Weeks 2 and 3 (M3/19, M 3/24, W 3/26): Basic Numerical Methods
    - Root Finding: Bisection
    - Root Finding: Newton Methods
        - Using Automatic Differentiation
        - Taylor Expansion
        - Solow Growth Model
    - Minimization with Scipy
        - Introduction to Simplex and Gradient-based method
    - Minimization with Gradient Descent
        - OLS with Gradient Descent
- Topic 4 - Weeks 4 and 5 (M 3/31, W 4/2, M 4/7): Data Management and Visualization
    - Pandas: Data Cleaning and Summarization
    - Matplotlib and Seaborn
    - Importing Economic Data with FRED API
    - (If time allows: Data Scrapping)
- Topic 4 - Weeks 5 and 6 (W 4/9, M 4/14): Simulation
    - Simulated Method of Moments
    - Monte Carlo Methods
    - (If time allows: Simple Schelling Model)
- Topic 6 - Weeks 6 (M 4/14, W 4/16): Solving Economic Models
    - Introduction to Dynamic Programming Problem
    - Cake Eating Problem
    - (If times allows: Consumption and Saving Problem with Income Fluctuation)

Date	**Topics/Assigned Readings/Homework**	**Major Assignments and Deadlines**
Week 1 (MW) 3/3, 3/5	Topic 1: Introduction to Python Programming	HW1 distributed on 3/5
	SPRING BREAK	
Week 2 (MW) 3/17, 3/19	Topic 2: Mathematical Operations Topic 3: Basic Numerical Methods	HW2 distributed on 3/19
Week 3 (MW) 3/24, 3/26	Topic 3: Basic Numerical Methods	HW1 due on 3/26 HW2 due on 3/26 HW3 distributed on 3/26

Week 4 (MW) 3/31, 4/2	Topic 4: Data Management and Visualization	HW3 due on 4/2 HW4 distributed 4/2
Week 5 (MW) 4/7, 4/9	Topic 4: Data Management and Visualization Topic 5: Simulation	HW4 due 4/9 HW5 distributed 4/9 *Research Question due on 4/10*
Week 6 (MW) 4/14, 4/16	Topic 5: Simulation Topic 6: Solving Economic Models	HW5 due 4/16 *Basic data plots due on 4/17*
Week 7 (MW) 4/21, 4/23	Final Presentations	Final Presentation

Bibliography

This is the list of resources that will be posted within Canvas. It is essential to explore real world data as a student in economics, and not only for your final project. Here are some examples:

1. On the Economy Blog, Federal Reserve Bank in St Louis: https://www.stlouisfed.org/on-the-economy
2. The Digest, NBER: https://www.nber.org/digest
3. American Economic Association – links to some data sources: https://www.aeaweb.org/resources/data. Also see the main landing page for featured research: https://www.aeaweb.org/

University-Wide Guidelines & Policies

Reporting Sexual Assault and Harassment

If a student discusses or discloses an instance of sexual assault, sex discrimination, sexual harassment, dating violence, domestic violence or stalking, or if a faculty member otherwise observes or becomes aware of such an allegation, the faculty member will keep the information as private as possible, but as a faculty member of Washington University, they are required to immediately report it to the Department Chair or Dean or directly to the Gender Equity and Title IX Compliance Office at (314) 935-3393 or titleix@wustl.edu. They will also offer available resources, including confidential support resources through the Relationship and Sexual Violence Prevention (RSVP) at 314-935-3445. Additionally, you can report incidents or complaints to the Office of Student Conduct and Community Standards or by contacting WUPD at (314) 935-5555 or your local law enforcement agency.
See: Gender Equity and Title IX Compliance Office

Disability Resources (DR)

WashU supports the right of all enrolled students to an equitable educational opportunity and strives to create an inclusive learning environment. In the event the physical or online environment results in barriers to the inclusion of a student due to a disability, they should notify the instructor as soon as possible.

Disabled students requiring adjustments to equitably complete expectations in this course should contact WashU's Disability Resources (DR) and engage in a process for determining and communicating reasonable accommodations. Because accommodations are not applied retroactively, DR recommends initiating requests prior to, or at the beginning of, the academic term to avoid delays in accessing accommodations once classes begin. Once established, responsibility for disability-related accommodations and access is shared by Disability Resources, faculty, and the student.
Disability Resources: www.disability.wustl.edu; 314-935-5970

Statement on Military Service Leave

Washington University recognizes that students serving in the U.S. Armed Forces and their family members may encounter situations where military service forces them to withdraw from a course of study, sometimes with little notice. Students may contact the Office of Military and Veteran Services at (314) 935-2609 or veterans@wustl.edu and their academic dean for guidance and assistance. See: https://veterans.wustl.edu/policies/policy-for-military-students/.

Preferred Name and Personal Pronouns

Washington University in St. Louis recognizes that many students prefer to use names other than their legal ones to identify themselves. In addition, in order to affirm each person's gender identity and lived experiences, it is important that we ask and check in with others about pronouns. This simple effort can make a profound difference in a person's experience of safety, respect, and support. See: Pronouns Information and Preferred Name.

Emergency Preparedness

Before an emergency, familiarize yourself with the building(s) that you frequent. Know the layout, including exit locations, stairwells and the Emergency Assembly Point (EAP). Review the "Quick Guide for Emergencies" that is found near the door in many classrooms and main lobby areas of buildings for specific emergency information and instructions. For additional Information and EAP maps, visit https://emergency.wustl.edu/. To ensure that you receive emergency notifications, make sure your information and cell phone number is updated in SIS, and/or download the WashU Safe app and enable notifications.

To report an emergency:
Danforth Campus: (314) 935-5555
School of Medicine Campus: (314) 362-4357
North/West/South and Off Campus: 911 then (314) 935-5555

Academic Integrity

Effective learning, teaching and research all depend upon the ability of members of the academic community to trust one another and to trust the integrity of work that is submitted for academic credit or conducted in the wider arena of scholarly research. Such an atmosphere of mutual trust fosters the free exchange of ideas and enables all members of the community to achieve their highest potential.

In all academic work, the ideas and contributions of others (including generative artificial intelligence) must be appropriately acknowledged and work that is presented as original must be, in fact, original. Faculty, students and administrative staff all share the responsibility of ensuring the honesty and fairness of the intellectual environment at Washington University in St. Louis.

For additional details on the university-wide Undergraduate Academic Integrity policy, please see: https://wustl.edu/about/compliance-policies/academic-policies/undergraduate-student-academic-integrity-policy/

Academic integrity is a serious offense that may lead to warning, suspension, or expulsion from the University. All instances of academic integrity allegations will be reported to Academic Integrity in the Office of the Provost, who will hold an initial meeting and then determine next steps with the student. For more information on the academic integrity policy, procedures, frequently asked questions, and who to contact, visit Academic Integrity in the Office of the Provost. The academic integrity policy, process, and information listed there applies to undergraduate students enrolled in all Schools and programs and master's level students in the McKelvey School of Engineering, the Sam Fox School of Design and Visual Arts, and the School of Continuing and Professional Studies. For all other programs, please see the Contacts page.

In all cases of academic integrity violations, the instructor shall make an academic judgment about the student's grade on that work and in that course, which shall not be considered a sanction for prohibited conduct under this policy.

Religious Holidays

As home to students, faculty, and staff of all the world's major religions and as a non-sectarian institution, Washington University in St. Louis values the rich diversity of spiritual expression and practice found on campus. It is therefore the policy of the university that students who miss class, assignments, or exams to observe a religious holiday should be accommodated. To ensure that accommodations may be made, students who plan to miss class for a religious holiday must inform their instructors in writing before the end of the third week of class, or as soon as possible if the holiday occurs during the first three weeks of the semester. Instructors should inform students on their syllabus and/or at the start of the class how they would like students to notify them of any accommodation needs related to religious observance. The university's Religious Holiday Class Absence Policy can be found here.

The Office of Religious, Spiritual and Ethical Life maintains a calendar of many religious holidays observed by the WashU community.

The **Jewish holidays** that may pose potential scheduling conflicts begin at sundown on the first d ay listed and end at nightfall of the last day shown:

April 12-14	Passover Opening Days
April 18-20	Passover Closing Days
June 1-3	Shavuot

Additionally, the Sabbath/Shabbat is celebrated each Friday at sundown though Saturday at nightfall.

Muslim students may require observance on the following days:

February 28-March 30 (approximately)	Ramadan
March 30-31 (approximately)	Eid al-Fitr

Unauthorized Recording and Distribution of Classroom Activities and Course Materials

Except as otherwise expressly authorized by the instructor or the university, students may not record, stream, reproduce, display, publish or further distribute any classroom activities or course materials. This includes lectures, class discussions, advising meetings, office hours, assessments, problems, answers, presentations, slides, screenshots or other materials presented as part of the course. If a student with a disability wishes to request the use of assistive technology as a reasonable accommodation, the student must first contact the Office of Disability Resources to seek approval. If recording is permitted, unauthorized use or distribution of recordings is also prohibited.

COVID-19 Health and Safety Protocols

Students experiencing symptoms consistent with COVID-19 or concerned about a possible exposure should contact Habif Health and Wellness Center (314 935-6666) to arrange for testing as indicated. If a student tests positive for Covid-19, they will receive a letter with instructions about any necessary isolation that they can share with their instructors. Any accommodation needs for COVID-related absence not covered in an instructor's standard course policies should be discussed between the student and instructor.

While on campus, it is imperative that students follow all public health guidelines established to reduce the risk of COVID-19 transmission within our community.

Masking: Masking remains a valuable tool in the mitigation of COVID-19, particularly in light of new and emerging variants. Students and instructors are encouraged to treat requests to mask with care and consideration, keeping in mind that some individuals may be at a higher risk, caring for others at a higher risk, or feeling less comfortable in a mask-optional environment. Based on monitoring of regional and campus conditions, a mask requirement may be implemented as needed.

Students with disabilities for whom masked instructors or classmates create a communication barrier are encouraged to contact Disability Resources (www.disability.wustl.edu) or talk to their instructor for assistance in determining reasonable adjustments. Adjustments may involve amplification devices, captioning, or clear masks but will not allow for the disregard of mask policies should a requirement be in place.

Resources for Students

Confidential Resources for Instances of Sexual Assault, Sex Discrimination, Sexual Harassment, Dating Violence, Domestic Violence, or Stalking

The University is committed to offering reasonable academic accommodations (e.g., a no-contact order, course changes) to students who are victims of relationship or sexual violence, regardless of whether they seek a formal investigation or criminal charges. If a student needs to explore options for medical care, other services, or reporting, or would like to receive individual counseling services, there are free, confidential support resources and professional counseling services available through the Relationship and Sexual Violence Prevention (RSVP) Center. If you need to request such accommodations, please contact RSVP to schedule an appointment with a confidential and licensed counselor. Although information shared with counselors is confidential, requests for accommodations will be coordinated with the appropriate University administrators and faculty. The RSVP Center is

located in Seigle Hall, Suite 435, and can be reached at rsvpcenter@wustl.edu or (314) 935-3445. For after-hours emergency response services, call the Sexual Assault and Rape Anonymous Helpline (SARAH) at (314) 935-8080 or call 314-935-6666 or (314) 935-5555 and ask to speak with an RSVP Counselor on call. See: RSVP Center.

Bias Reporting and Support System (BRSS)

The University has a non-punitive process through which students, faculty, staff, and community members who have experienced or witnessed incidents of bias, prejudice, or discrimination against a student can report their experiences to the University's Bias Report and Support System (BRSS) team.

Center for Career Engagement (CCE)

The Center for Career Engagement provides one-on-one coaching, resources, programs and events to support the lifelong career success of all students and alumni. In addition to having your resume reviewed or fine-tuning your interviewing skills, the CCE invites you to work with us as partners at every stage of your career development as you reflect, learn and experiment. Our Certified Career Management Coaches will listen, ask questions, and provide resources to help you understand yourself, envision possibilities, prepare, search and apply, and engage in your career development.
You can select a career coach based on availability and alignment with one of our industry-aligned career communities, or you can choose a coach in the Career Exploration community.

To make an in-person or virtual appointment:

1. Log in to Handshake
2. Click Career Center (left side tool bar)
3. Click Appointments.

The CCE is conveniently located in the Danforth University Center, Suite 110 with several additional office spaces across campus in Knight Hall 210, Bauer Hall 250, Steinberg Hall and Brown Hall.

Counseling and Psychological Services

The Center for Counseling and Psychological Services' professional staff members work with students to resolve personal and interpersonal difficulties, many of which can affect a student's academic experience. These include conflicts with or worry about friends or family, concerns about eating or drinking patterns, and feelings of anxiety, depression, and thoughts of suicide. Individual, Conjoint, and Group therapy are all provided in addition to referrals for off-campus support. Information can be found on the CCPS webpage.

The Division of Student Affairs also offers a telehealth program to students called TimelyCare. While students are encouraged to visit CCPS during business hours, this additional service also provides after-hours access to medical care and 24/7 access to mental telehealth care across the United States, with no cost at the time of the visit. 12 counseling visits are provided at no charge as well as a limited number of psychiatry appointments. Students who pay the Health and Wellness fee are eligible for this service.

Additionally, see the mental health services offered through the RSVP Center.

WashU Cares

WashU Cares specializes in providing referrals and resources, both on and off campus for mental health, medical health, financial and academic resources by using supportive case management. WashU Cares also receives reports on students who may need help connecting to resources or whom a campus partner is concerned about. If you are concerned about a student or yourself, you can file a report here: https://washucares.wustl.edu/.

The Writing Center

The Writing Center offers free writing support to all Washington University undergraduate and graduate students. Staff members will work with students on any kind of writing project, including essays, writing assignments, personal statements, theses, and dissertations. They can help at any stage of the process, including brainstorming, developing and clarifying an argument, organizing evidence, or improving style. Instead of simply editing or proofreading papers, the tutors will ask questions and have a conversation with the writer about their ideas and reasoning, allowing for a higher order revision of the work. They will also spend some time looking at sentence level patterns to teach students to edit their own work.

The Center is located in Mallinckrodt, and appointments are available days and evenings Sunday through Friday. Office staff hours are Monday through Friday 10:00am to 4:00pm. Students are seen primarily by appointment, with walk-ins accepted as the schedule allows. They also have dedicated walk-in hours for undergraduates on Tuesday and Wednesday afternoons. Both in-person and online appointments are available. To make an appointment, go to writingcenter.wustl.edu. Email: writing@wustl.edu.

The Learning Center

The Learning Center provides peer-led support programs, including course-specific mentoring and academic skills coaching (study and test-taking strategies, time management, etc.), that enhance undergraduate students' academic progress. Contact them at learningcenter@wustl.edu or visit ctl.wustl.edu/learningcenter to find out what support they may offer for your classes.

Center for Diversity and Inclusion (CDI)

The Center for Diversity and Inclusion (CDI) supports and advocates for all undergraduate, graduate, and professional school students, especially from underrepresented and/or marginalized populations, collaborates with campus and community partners, and promotes dialogue and social change to cultivate and foster a supportive campus climate for students of all backgrounds, cultures, and identities. Additional Diversity and Inclusion information can be found at https://diversityinclusion.wustl.edu/. The CDI consists of the following offices and is physically located in the Danforth University Center (DUC) Suite 150 and the Women's Building Room 102.

- Cross-Cultural Connections (CCxN) – DUC 150
- Dialogue across Difference (DxD) – DUC 150
- Office for International Student Engagement (OISE) – Women's Building 102
- Office for Religious, Spiritual and Ethical Life (ORSEL) – DUC 150
- Spectrum Office (LGBTQIA+ Support) – DUC 150

Gephardt Institute

Students play an essential role in a vibrant and functioning democracy! In addition to the November General Elections, state and local elections take place throughout the year and have a direct impact on our communities. You can register to vote, request an absentee ballot, confirm your polling location, and get Election Day reminders at http://wustl.turbovote.org for any of the 50 states and Washington D.C. WashU students are considered Missouri residents, and eligible student voters can register to vote in the state of Missouri or their home state.

To vote in Missouri, you will need a photo ID issued by the state of Missouri (e.g., driver's license or state ID) or a photo ID issued by the United States government (e.g., passport). More information about voter identification in Missouri can be found at *https://www.sos.mo.gov/voterid*.
If you are ineligible to vote, you can participate by encouraging your friends to register and vote, engaging your peers in local issues, and taking part in other civic and community engagement activities. For more resources on voting and other civic and community engagement opportunities, please visit http://vote.wustl.edu and http://gephardtinstitute.wustl.edu.

University Libraries

WashU Libraries include seven unique locations across the Danforth Campus, but they are much more than just beautiful, quiet spaces for studying and group work. The Libraries include librarians for every discipline on campus, with the expertise to work with you to develop research ideas and find the best resources to meet your needs; you are also encouraged to explore our research guides, tailored for each subject and available online. The Libraries hold over five million items in the collections—print books, journals, electronic resources, databases, and millions more accessible through interlibrary loan—and you can find it all at the search on our home page. Additional resources for students include special collections, data services, citation help, digital publishing, and more. Visit the Libraries website for more details about these and other ways that the Libraries are here to support your academic success.