

# PHY316: Econophysics

## Spring 2024

### General Information

Course Time and Place: Tues. and Thurs. 11AM-12:20PM EST in PB 204  
Instructor: Professor J. M. Schwarz, aka Professor Jen  
Office: 207 Physics Building  
Phone: 607-342-0876  
Slackpage:  
Course webpage: [jmschwarztheorygroup.org/phy316](https://jmschwarztheorygroup.org/phy316)  
Office Hours: TBD

### Professor Jen's Reason to Take This Course

The world's financial system is indeed a complex one. Just as physicists such as myself are tackling the mysteries of biology from the chromatin scale to the tissue scale, for example, why should we limit ourselves to biology? If we view the world's financial system as a physical one with agents as particles and old-fashioned money or new-fashioned bit-coin as the interaction medium, can we make predictions about certain aspects of the system just as physicists make predictions about systems composed of dead matter? And while predictions are the ultimate goal of any theory that are then tested in experiments, predictions for the world's financial system have not yet been successful. Perhaps because our modeling is not sophisticated enough? Given the abundance of financial data out there, what is clear is that there exist trends that one often sees in the natural world and so viewing the world's financial system as a physical system is indeed a productive perspective as we shall see throughout the course. To be able to make accurate predictions in economics will take a bit more work as we shall also see throughout the course.

To understand economics through the eyes of a physicist, we will explore such physics topics as random walks, statistical mechanics, and network theory. We will use such topics to better understand stock price fluctuations, the basis for economic inequality, and nonequilibrium phase transitions driven by the formation and collapse of market "fads", to name a few. All material covering these topics will be provided on the course webpage.

To be able to achieve our goal of understanding economics through the eyes of a physicist, we will acquire skills for collecting data and analytical and computational modeling to interpret the data. As the analytical and computational modeling will be rooted in physics concepts, we will be making explicit connections between physics and economics. These skills will be perfected by attending classes, completing the expected readings, the mini-projects on a somewhat weekly basis that perhaps will involve use of a small piece of computer code (in Python most likely), and *anti-quizzes* from time to time. An anti-quiz asks for a question (as opposed to an answer) and an idea as to how to *begin* to answer the question. There will also be one exam and one final (not-mini) project, involving both a written and a presentation component, to help perfect your skills.

## Textbook

While there is no one textbook for *our* class, we will draw on several chapters from *Financial Market Complexity* by Neil F. Johnson, papers by Victor Yakovenko, a physics professor at the University of Maryland, College Park, and his collaborators, and several other sources. Again, this material will be provided on the course webpage.

## Assessment of Your Work

(1) Class participation (15 percent): You are encouraged to attend class and to ask questions. Anti-quizzes are included in this part of your grade.

(2) Mini-projects (30 percent): There will be approximately 7-8 mini-projects. If you have used any resources other than your brain, which has been nourished by the textbooks, to complete the mini-project, please cite them. (I must also remind you that the Syracuse University Academic Integrity Policy holds students accountable for the integrity of the work they submit. For the complete policy, see <http://academicintegrity.syr.edu>.)

(3) Midterm (20 percent): There will be one test.

(4) Final Project (35 percent): The final project will consist of a written component and a presentation component. The econophysics topic will be chosen by the student (after discussion with me) soon after the midpoint of the course.

## Prerequisites

Officially, one is supposed to take PHY212 or PHY216 or ECN 101 and 102 as well as MAT 295 and MAT 296. Some familiarity with “basic” physics is assumed, but not much more than that. We will construct as much as we can from the ground up in terms of the physics.

## Meeting Logistics

;

We will be meeting in classroom PB204. However, should the university decide that we need to hold classes on-line due to COVID-19 conditions, or snow conditions make driving dangerous, we will meet on Zoom.

In the event that we hold class via Zoom, please keep your microphone muted unless you are actively talking to your fellow classmates (myself included); this is especially important if you are in a noisy place, or if you are using a built-in microphone on a laptop or cellphone. *Please introduce yourself before speaking.*

Should you have to miss class due to COVID-19, to access the homework and any additional reading material, please visit the course webpage. There will also be a weekly posting about the topics covered keep you up to date with the course. If you are feeling well enough but still need to quarantine, there is the possibility of joining the class remotely. Please let me know.

## Public Health

While we have discussed the nuts and bolts of the course, my highest priority this semester is the preservation of your health (and mine). So, if you are not feeling well, one of the most important things you can do is to stay home. Many of the components of our class can be done remotely, and if you are feeling unwell – particularly if your symptoms involve nausea, cough, fever, or others common in COVID-19 – you should reach out to me so that I can make accommodations. We often have a culture of trying to “push through” when we are not feeling well, saying things like “Yeah, I am sick, but I will be okay – I can still go to class”. While this sort of perseverance in general is a good thing, coming to class when you’re sick puts other people’s health at risk. So, if you have any symptoms at all, stay home. Moreover, the Center for Disability Resources also helps students with short-term injuries and illnesses – concussions, broken bones, etc. If you are sick or hurt, I will work with you and with CDR to do whatever I can to accommodate your condition. Additionally, if you miss a large amount of class (two weeks or more), you may be eligible to take an “incomplete grade” in the course. This is a “grade pending” status that means that you were not able to finish all your work during the semester. Once you finish up your work in the summer, I can go back and give you your final grade. If you think you might need to use this option, it is important to talk to me as early as possible so we can discuss arrangements. In general, only students who have completed a meaningful amount of classwork with a passing grade are eligible to take an incomplete.

## Equality and Inclusiveness

Everyone in this class is an equally-valued member of this university and our community. I expect you to treat your classmates as honored colleagues in the collective endeavor we are all involved in: to understand the world, both natural and constructed by us (though other species also construct things) and use that understanding to improve our society.

In particular, bias against or denigration of anyone in our class because of their gender or how they express it, their sexual orientation, their religion, their national origin, their race or ethnicity, or a disability they may have will not be tolerated. If you are the target of this sort of bias or if you witness it, please report it directly to me and I will take swift action. If you don’t feel comfortable talking to me, you may report it anonymously to the Physics Department at:

<https://docs.google.com/forms/d/e/1FAIpQLScNduLL1hc9fJu5MRaKjajJFnlTDiDio0xvqprn9kCXDpS2Cg/viewform>.

## Syllabus Statement Regarding Disability-Related Accommodations

Students who are in need of disability-related academic accommodations must register with the Office of Disability Services (ODS), 304 University Avenue, Room 309, 315-443-4498. Students with authorized disability-related accommodations should provide a current Accommodation Authorization Letter from ODS to the instructor and review those accommodations with the instructor. Accommodations, such as exam administration, are not provided retroactively; therefore, planning for accommodations as early as possible is necessary. For further information, see the ODS website, Office of Disability Services <http://disabilityservices.syr.edu/>.

## SU Religious Observances Policy

The policy, found at [http://supolicies.syr.edu/emp\\_ben/religious\\_observance.htm](http://supolicies.syr.edu/emp_ben/religious_observance.htm), recognizes the diversity of faiths represented among the campus community and protects the rights of students, faculty, and staff to observe religious holy days according to their tradition. Under the policy, students are provided an opportunity to make up any examination, study, or work requirements that may be missed due to a religious observance provided they notify their instructors before the end of the second week of classes. For both fall and spring semesters, an online notification process is available through MySlice/Student Services/Enrollment/My Religious Observances from the first day of class until the end of the second week of class.

## Secret Course Objective

To have **fun** solving the mysteries of economics using physics, where **fun** means that the learning experience should be enjoyable and inspiring.