

AMS 515: Case Studies in Machine Learning and Finance

Spring 2023

Credits and Grading: 3 credits, ABCF grading

Instructor: Stan Uryasev, Math Tower, 148 B, stanislav.uryasev@stonybrook.edu

Office hours: Tuesday and Thursday 10:30-11:30, by using Zoom.

Course Web Site and Blackboard: Refer to Blackboard, where course notes, articles, solutions and slides are posted, and videos of lectures are available for download.

Lectures: Tuesday and Thursday, 6:30-7:50PM, Psychology A 144 (onsite students) and with Zoom (online students).

Teaching Assistant: Cheng Peng, e-mail: cheng.peng.1@stonybrook.edu

Office hours: Tuesday and Thursday 9:00-10:00, by using Zoom.

Text: There are NO REQUIRED textbooks.

Supplemental reading: Zabaranin, M. and S. Uryasev. Statistical Decision Problems. Selected Concepts and Portfolio Safeguard Case Studies. Optimization and Its Applications, Vol. 85, Springer, 2014. Print ISBN: 978-1-4614-8470-7, Electronic ISBN: 978-1-4614-8471-4 .

<http://www.springer.com/mathematics/applications/book/978-1-4614-8470-7>

Prerequisites: Basic knowledge of high-level programming environments: MATLAB or R (or a strong desire to learn).

Policies:

- Students are supposed to attend in-class lessons (onsite students) and Zoom lessons (online students). 5% of grade is based on attendance.
- For in-class lecture periods, please silence your phone (and other electronic devices) beforehand.
- For online lecture periods and recitations, please mute your microphone unless you are speaking or otherwise directly participating in the discussion.

Exams: This class does not have exams. Grading is based on homeworks and the project.

Homeworks: Homeworks covering main material of the course will be graded. For homework problems, you are expected to write up your solutions *on your own*, **without referring to other students' writeups or to solutions you may find on the web**; you are welcome to discuss the problems with TA, and classmates, but **must do the writeup entirely on your own. Homework submission delay up to 2 days will result in the 50% loss of points. Homework will not be accepted after 2 days of delay.** In case of some events (such as a conference) or important reasons (e.g., health issues) delay may be granted to some students.

Project: Every student will do a project (case study) and present in the class. **The project should be based on learned in this course methodologies and numerical techniques.** Also, students review projects of their peers and present the review report in the class.

Grades: We will use your total average score to assign a letter grade; there is no pre-established scale or curve. It is expected that 40-50% of students receive A/A-, and 40-50% receive B+/B/B- grades (with a few outliers having lower grades).

Assignment	Percentage of Final Grade
Homework	50%
Project	40% (see project requirements)
Project review	5%
Attendance	5%
Total	100%

Course Objectives : The course covers applications of Quantitative Finance to risk assessment, portfolio management, cash flow matching, securities pricing and other topics. Particular attention is paid to machine learning approaches, such as neural networks and support vector machines, data collection and analysis, the design and implementation of software. We study differences between theory and practice in model application, including in-sample and out-of-sample analysis. Numerical exercises and projects in a high-level programming environment are assigned.

List of Course Topics:

1. Support Vector Machines Based on Various Risk Measures
2. Logistic Regression with Factors Transformed by Splines and Approaches for Dimension Reduction
3. Neural Networks and Backpropagation Algorithm
4. Peer-to-Peer Lending: Classification in Loan Application Process
5. Introduction to Tail Risk Measures: VaR, CVaR, POE, bPOE
6. Cash Flow Matching Algorithms
7. Calibrating Risk Preferences with Generalized Capital Asset Pricing Model (CAPM)
8. Pricing Derivatives: Optimization vs Stochastic Differential Equations
9. Management of Drawdown in Active Investments: Portfolio Optimization and Drawdown Beta
10. Peer-to-Peer Lending: Classification in Loan Application Process

Information Dissemination:

This course uses Blackboard (<https://blackboard.stonybrook.edu>) to facilitate communications between faculty and students, submission of assignments, and posting grades. See the “Technical Requirements” section for more information.

Technical Requirements

You are responsible for having a reliable computer and Internet connection throughout the term. The following list details a minimum recommended computer set-up and the software packages you will need to access and use:

Hardware:

- PC (Windows 7 or higher) or Macintosh (OS X/macOS 10.10 or higher).
- 4 GB RAM.
- A high-speed internet connection.
- Speakers (either internal or external) or headphones. Headphones are strongly recommended to reduce the risk of feedback during communications.

- Microphone (either internal or external).
- WebCam or other camera (interfacing with your computer) for producing video.

If you are unsure of your NetID, visit <https://it.stonybrook.edu/help/kb/finding-your-netid-and-password> for more information. Software (additional tools may be needed). Remember to use your Stony Brook email or NetID when configuring specialized software:

- An up-to-date Internet browser, such as Chrome, Firefox, Explorer/Edge (Windows), or Safari (macOS). A complete list of supported browsers and operating systems can be found on the MyInstitution page when you log in to Blackboard.
- PDF viewer, such as Adobe Reader.
- Zoom. Stony Brook has a site license for Zoom; you can find information on downloading, installing, and using Zoom: <https://it.stonybrook.edu/services/zoom/students>

Student Accessibility Support Center (SASC) Statement: If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, 128 ECC Building, (631) 632-6748, or via e-mail at: sasc@stonybrook.edu. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

Academic Integrity Statement: Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website at http://www.stonybrook.edu/commcms/academic_integrity/index.html.

Critical Incident Management Statement:

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Student Conduct and Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Until/unless the [latest COVID guidance](#) is explicitly amended by SBU, during Spring 2022 "disruptive behavior" will include refusal to wear a mask during classes.

Student Absences Statement: Students are expected to attend every class, report for examinations and submit major graded coursework as scheduled. If a student is unable to attend lecture(s), report for any exams or complete major graded coursework as scheduled due to extenuating circumstances, the student must contact the instructor as soon as possible. Students may be requested to provide documentation to support their absence and/or may be referred to the Student Support Team for assistance. Students will be provided reasonable accommodations for missed exams, assignments or projects due to significant illness, tragedy or other personal emergencies. In the instance of missed lectures or labs, the student is responsible for *insert course specific information here (examples include: review posted slides, review recorded lectures, seek notes from a classmate or identified class note taker, write lab report based on sample data)*. Please note, all students must follow Stony Brook, local, state and Centers for Disease Control and Prevention (CDC) guidelines to reduce the risk of transmission of COVID. For questions or more information click [here](#).