

ISyE 6405: Statistical Methods for Manufacturing Design/Improvement Fall 2026

Lecture Time: Tuesday and Thursday, 5:00 pm – 6:15 pm (ET)

Lecture Room: George Tower Room 1002

Course Canvas Website: <https://gatech.instructure.com/courses/456100>

Why Take ISyE 6405?

Modern manufacturing, healthcare, and service systems generate high-dimensional, time-dependent data, making quality monitoring, diagnosis, and control increasingly challenging. This course develops statistical and data-analytic methods for detecting process changes, identifying sources of variation, forecasting system behavior, and supporting process improvement. Topics include advanced statistical process control, multivariate monitoring and dimension reduction, time-series modeling and predictive control, and selected Artificial Intelligence and Machine Learning (AI/ML) methods for quality improvement. Through real case studies and a student-selected term project, students will learn to combine engineering knowledge with data analysis to solve practical problems.

Modality:

- In person on campus, lecture presentation files will be posted in Canvas before each lecture.
- Virtual office hours are optional.

Instructor:

- Jan Shi, shi@isye.gatech.edu, Phone: 404-385-3488, Room 820, George Tower
- Office hours: By appointment.
- Link: <https://gatech.zoom.us/my/jianjun.shi> [Links to an external site.](#)

Teaching Assistant:

- Yifeng Wang, ywang3989@gatech.edu, Room 824, George Tower

Communication and Students/Instructor/TA Interactions

- This term we will use Piazza in Canvas for class discussion. The system is highly catered to get help fast and efficiently from classmates, the TA, and instructor. Rather than emailing questions to the teaching staff, we strongly encourage you to post your questions on Piazza. It is recommended to check Piazza at least weekly so that you can learn from questions from other peer students. Besides, please review posted questions before posting a new one. Sometimes, they have already been addressed. If you have further questions regarding the same one, please feel free to post your follow-up questions under the same page. For non-Piazza communications, please e-mail your course-related questions to both TA and instructor simultaneously to ensure a timely response.
- Find our class signup link
at: https://gatech.instructure.com/courses/456100/external_tools/18649

Required Textbook: NONE (course pack/handout will be posted on Canvas)

- Here is a list of recommended references that are related to different modules:
- Douglas C. Montgomery “Introduction to Statistical Quality Control”, 8th edition, Wiley.
 - (Note: It does not need to be the 8th edition of the book. The previous edition of the book will be fine for you to study.)
- On multivariate monitoring: R. A. Johnson and D. W. Wichern (2001). *Applied Multivariate Statistical Analysis* (5th), Upper Saddle River, NJ: Prentice Hall.

Tentative Course Topics

Module 1: Basics of Change Detection and Statistical Process Control

- Review of basic statistics and statistical process control (SPC)
- Risk-adjusted control charts and its application in health care

Module 2: Multivariate Statistics Change Detection and Analysis

- Multivariate statistics and multivariate change detection (T^2 , multivariate CUSUM and EWMA)
- Principal Component Analysis and Variation Reduction with applications

Module 3: Time Series Modeling, Analysis and Control

- Time series modeling, analysis, and forecasting
- Predictive control and integration of SPC and APC

Module 4: AI/ML for Quality Improvement and Smart Manufacturing

- AI/ML enabled quality improvements: methodology and implementation
- Advanced topics of data analytics with applications in smart manufacturing

Learning Outcomes

By the end of the course, students will be able to:

- Select and interpret advanced control-chart methods for process monitoring and change detection.
- Apply multivariate monitoring and principal component analysis for process diagnosis and variation reduction.
- Develop time-series models for forecasting and predictive process control.
- Integrate engineering knowledge with statistical and selected AI/ML methods in an applied term project.

Preferred Background

- Linear Algebra or Matrix Algebra
- Knowledge of hypothesis testing, likelihood function, and linear regression

Grading:

Homework	(as assigned)	20%
Exam 1	(Oct. 22, Thursday)	25%
Exam 2	(Dec. 1, Tuesday)	25%
Term Project	(Presentations: Dec. 3 and Dec. 8)	30%

Course Policies

Homework: We will have 4-5 homework assignments, consisting of conceptually, theoretically, and computationally oriented problems. All homework submission should be submitted through the canvas system, and no hard copy is accepted. You should not read, review, or reference the homework problems from previous semesters. You are expected to observe the *Georgia Tech Honor Code* in the preparation of their solutions. You may discuss the problem assignments with other students. However, each student must work independently on the assigned problems and the preparation of the submitted solution. The specified due dates must be strictly observed.

You are also expected to observe the *Georgia Tech Honor Code* throughout the course. The related information can be found at

- Honor Code: <http://osi.gatech.edu/content/honor-code> [Links to an external site.](#)
- Disability Services: <http://disabilityservices.gatech.edu> [Links to an external site.](#)

Project: Throughout the semester, each student will also work on a project. The topic of the project will be defined on the basis of the students' interests and must be approved by the instructor. In general, the selected topics should extend the class experience by researching further some of the material presented in class. The developed results will be presented in the class and shared with the rest of the class. Finally, group projects are also possible, provided that the research topic undertaken justifies the size of the group.

Detailed information about the group project can be found on Canvas. Here are some important dates:

- Determine Group Members: Oct 2, 2026, at 11:59 pm ET
- Abstract: 30, 2026, at 11:59 pm ET

- Report due: 3, 2026, at 11:59 pm ET
- Presentations: 3 & Dec. 8, 2026

Regrade Requests:

- Regrade requests for assignments must be within 5 working days of when you received the grade/feedback. Only written complaints (Email “Regrade Form ISYE 6405” to Instructor and TA) will be accepted.
- Mode of Regrade Request: If there is a regrade request, we will have written exchange first. If necessary, in person discussion will be followed, determined by the grader.
- Looking to Improve Your Grade: If you are working hard in this course but feel that your assignment grades do not reflect your work, please come to see the TA and the Instructor first. If you cannot make office hours, or they seem too busy, email the TA to make an appointment for another time. You may be spending a lot of time on the wrong things and redirecting your efforts may really pay off.

Further Notes on Grading/Assignments

- There will be 4-5 homework assignments.
- The term project is a multi-week endeavor – please make sure to complete small milestones each week, so you don't fall behind and need to rush at the end.
- There will be no extra assignments to bump up your grade.
- There will be two exams. All exams are in class, and there will be no make-up exams. Only absences approved by the Division of Student Life, or Dean of Students, or official approval from the registrar are valid excuses for missing an exam and you will be given a make-up exam.