

## **Data Analytics for System Monitoring**

ESI 6616

**Class Periods:** M,W,F | Period 9 (4:05 PM - 4:55 PM)

**Location:** WEIL 0234

**Academic Term:** Fall 2025

### **Instructor:**

Dr. Minhee Kim

[mkim3@ufl.edu](mailto:mkim3@ufl.edu)

Office Hours: Tuesday 3~5 PM via Zoom (link in Canvas)

**Office Location:** Weil 0417

### **Teaching Assistant/Peer Mentor/Supervised Teaching Student:**

- None

### **Course Description**

The course focuses on advanced data analytics techniques for modeling, monitoring, diagnosis, and quality improvement of industrial processes. The techniques introduced have wide applications in manufacturing, health care, service industry applications, and human factors.

### **Course Pre-Requisites / Co-Requisites**

ESI 6325 or Permission by Instructor

### **Course Objectives**

This course will provide the students with understanding of the fundamental and advanced data analytics methodologies on system monitoring, and the ability of formulating and solving real problems with the appropriate modeling strategies and statistical principles. At the completion of this course, it is intended that students will be able to understand and apply techniques including:

- Univariate Statistical Process Control (SPC) on continuous data
- Cumulative sum (CUSUM) and Exponential Weighted Moving Average (EWMA) control charts
- Risk-adjusted control charts
- Multivariate statistics and multivariate SPC
- Data reduction and principle component analysis
- Quality control for autocorrelated data

### **Materials and Supply Fees**

- None

### **Required Textbooks and Software**

- Introduction to Statistical Quality Control, 7th edition, D.C. Montgomery, Wiley & Sons, 2013.
- Coding is expected for completion of the project. However, this is NOT a software-teaching course. You are free to use any other software you are familiar with.

### **Recommended Materials**

- Applied Multivariate Statistical Analysis, 5e, 2002, R. A. Johnson and D. W. Wichern, Wiley, New York.
- In addition, some topics will not be from this book, but in lecture notes.

### **Required Computer**

UF student computing requirement: <https://news.it.ufl.edu/education/student-computing-requirements-for-uf/>

### Course Schedule (Tentative)

Week	Lecture Topics	Book Chapter	Homework Due Dates
1	Course Introduction		
2	Introduction to statistical process control (SPC), hypothesis testing	Chapters 4, 5	
3			
	<b>Holiday</b>		
	Univariate SPC for continuous data (Homework 1 assigned.)	Chapter 6	
4	CUSUM and EWMA control charts	Chapter 9	
	<i>Homework 1 Due</i>		
5	Univariate SPC for discrete data (Homework 2 assigned.)	Chapter 7	
6	Risk-adjustment control charts	Chapter 12	
7	Multivariate SPC (Shewhart Chart) (Homework 3 assigned.)	Chapter 11	
	<i>Homework 2 Due</i>		
8	Multivariate SPC (mCUSUM, mEWMA)	Chapter 11	
	<i>Homework 3 Due</i>		
9	Exam Review		
	Midterm Exam		
	<b>Homecoming Day</b>		
10	Principle component analysis for monitoring (Homework 4 assigned.)	Lecture notes	
	<i>Project abstracts submission</i>		
11	Principle component analysis for monitoring		
12	Time series model for autocorrelated data monitoring (Homework 5 assigned.)	Chapter 10	
	<i>Homework 4 Due</i>		
13	<b>Holiday</b>		
	Basics of degradation modeling and monitoring (Homework 6 assigned.)	Lecture notes	
14			
	<i>Homework 5 Due</i>		
15	<b>Thanksgiving Holidays</b>		
16	Project and Presentation and Exam Review		
	<i>Project Report and Homework 6 Due</i>		
17	Final Exam		

### Attendance Policy and Class Expectations

This course is delivered in person and there will be required in class activities. Attendance will be assessed using iClicker questions. The instructor will not repeat material in office hours just because you chose not to attend class.

### Absences

- Excused absences must be consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation.
  - “For all planned absences, a student in a situation that allows an excused absence from a class, or any required class activity must inform the instructor as early as possible prior to the class. For all unplanned absences because of accidents or emergency situations, students should contact their instructor as soon as conditions permit.”*
- An excused absence from class does not excuse you from fulfilling class requirements (i.e.. You will still be expected to complete the assignments that were given in class).
- The posted lecture slides will not have all the information. In class, you will have the opportunity to follow along and fill in the slides.
- A note indicating that you were seen at the health center the day of the exam is not sufficient documentation of a medically excused absence from an exam. The note must say that you were medically unable to take the exam.
- In case of an exam conflict, you will need to present evidence of the conflict to the instructor.

### Evaluation of Grades

Assignment	Percentage of Final Grade
Homework Sets	25%
Project	30%
iClicker	5%
Midterm Exam	15%
Final Exam	20%
Total	100%

### Assignments Homework (25%)

There will be 6 homework assignments throughout the semester, the material of which will be drawn from the textbook and lectures. Coding is expected in home exercises to practice fundamental methods learned in class. Homework assignments must be done individually.

### Exam (40%)

There will be two exams in this class. The syllabus for each exam will be announced in the class. One-page double-sided hand-written cheat sheet and calculator are allowed. No coding is expected for the exam.

### Project (30%)

Students are required to work on a project in the context of data analytics and system monitoring to practice the learned skills and explore more methodologies and applications. Students will be working in a group of two, and finish project in one of the following three formats: (i) focused study on a concept/technique from the course pack or lecture material, (ii) focused study on an application or a dataset related to a specific topic or domain of problems, and (iii) advanced theoretical topic to develop a new technique or a new interpretation of an existing technique. An in-class presentation and a report are expected for all teams at the end of the semester. These deliverables should describe clearly the background, objectives, proposed/reviewed concepts/techniques, analysis, results, and conclusions.

### Grading Policy

Final Grades will be based on classroom participation, exams, projects, and homework assignments and it will be rounded off to the nearest integer, and assigned on the standard scale as follows:

Percent	Grade	Grade Points
93.4 - 100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

Exam/Homework grade disputes/inquiries must be made to the instructor within one week after grades are posted. Any grade dispute/inquiry after the specified period will not be considered.

More information on UF grading policy may be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

### ***Exam and Make-Up Policy***

To assess student learning, students will be given two exams and one project. The syllabus for each exam will be announced in the class. Missing an exam without substantial **PRIOR** notification will result in a zero grade for that exam. No make-up exam is allowed except for unanticipated absences **ONLY** (e.g., illness with a doctor's report, death in family, but **NOT** for Employment interviews, employer events, weddings, vacations, etc). Excused absences must be consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation. If you missed an exam due to a health problem, you will need to provide documentation that indicates the date of the visit. A note indicating that you were seen at the health center the day of the exam is not sufficient documentation of a medically excused absence from an exam. The note must say that you were medically unable to take the exam. In case of an exam conflict, you will need to present evidence of the conflict to the instructor ONE week prior to the exam.

### ***Students Requiring Accommodations***

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

### ***Course Evaluation***

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluer.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

### ***Online Course Recording***

Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively

using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

### ***In-Class Recording***

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

### ***University Honesty Policy***

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Conduct Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. If you have any questions or concerns, please consult with the instructor or TAs in this class.

### ***Commitment to a Safe and Inclusive Learning Environment***

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Undergraduate Coordinator
- HWCoe Human Resources, 352-392-0904, [student-support-hr@eng.ufl.edu](mailto:student-support-hr@eng.ufl.edu)
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, [pld@ufl.edu](mailto:pld@ufl.edu)

### ***Software Use***

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

## ***Student Privacy***

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

## ***Campus Resources:***

### ***Health and Wellness***

#### **U Matter, We Care:**

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

**Counseling and Wellness Center:** <https://counseling.ufl.edu>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

#### **Sexual Discrimination, Harassment, Assault, or Violence**

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto:title-ix@ufl.edu)

#### **Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

### ***Academic Resources***

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu).  
<https://elearning.ufl.edu/>.

**Career Connections Center**, Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.edu>.

**Library Support**, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.  
<https://teachingcenter.ufl.edu/>.

**Writing Studio, 302 Tigert Hall**, 846-1138. Help brainstorming, formatting, and writing papers.  
<https://writing.ufl.edu/writing-studio/>.

**Student Complaints Campus:** <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

**On-Line Students Complaints:** <https://distance.ufl.edu/getting-help/>; <https://distance.ufl.edu/state-authorization-status/#student-complaint>.