

EIN 6905 Data Analytics for System Monitoring

Class Periods: MWF 12:50 pm – 1:40 pm

Academic Term: Fall 2020

Instructor:

Xiaochen Xian, xxian@ufl.edu, 352-294-7713

Office Hours: MW 1:40 pm – 2:40 pm, [Zoom link](#)

Grader:

TBA

Zoom meeting link:

[Monday](#), [Wednesday](#), [Friday](#).

Course Description (3 Credits)

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
- Basics on degradation modeling and monitoring

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.

Course Schedule

	Topic	Book Chapter	Exam and HWs
Week 1	Introduction to statistical process control (SPC), hypothesis testing	Chapter 4, 5	
Week 2	Univariate SPC for continuous data	Chapter 6	HW1
Week 3	CUSUM and EWMA control charts	Chapter 9	
Week 4	Univariate SPC for discrete data	Chapter 7	HW2
Week 5	Risk-adjustment control charts	Chapter 12	
Week 6	Multivariate SPC (Shewhart Chart)	Chapter 11	HW3

Week 7	Multivariate SPC (mCUSUM, mEWMA)	Chapter 11	
Week 8	Principle component analysis for monitoring	Lecture notes	HW4
Week 9	Exam and review		Exam
Week 10	Principle component analysis for monitoring	Lecture notes	Project abstracts submission
Week 11	Time series model for autocorrelated data monitoring	Chapter 10	HW5
Week 12	Basics of degradation modeling and monitoring	Lecture notes	
Week 13	Basics of degradation modeling and monitoring	Lecture notes	HW6
Week 14	Project and presentation		
Week 15	Project and presentation		Project due date

Face-to-face instructional sessions

We will have face-to-face instructional sessions to accomplish the student learning objectives of this course. In response to COVID-19, the following policies and requirements are in place to maintain your learning environment and to enhance the safety of our in-classroom interactions.

- You are required to wear approved face coverings at all times during class and within buildings. Following and enforcing these policies and requirements are all of our responsibility. Failure to do so will lead to a report to the Office of Student Conduct and Conflict Resolution.
- This course has been assigned a physical classroom with enough capacity to maintain physical distancing (6 feet between individuals) requirements. Please utilize designated seats and maintain appropriate spacing between students. Please do not move desks or stations.
- Sanitizing supplies are available in the classroom if you wish to wipe down your desks prior to sitting down and at the end of the class.
- Follow your instructor's guidance on how to enter and exit the classroom. Practice physical distancing to the extent possible when entering and exiting the classroom.
- If you are experiencing COVID-19 symptoms ([Click here for guidance from the CDC on symptoms of coronavirus](#)), please use the UF Health screening system and follow the instructions on whether you are able to attend class. [Click here for UF Health guidance on what to do if you have been exposed to or are experiencing Covid-19 symptoms.](#)
- Course materials will be provided to you with an excused absence, and you will be given a reasonable amount of time to make up work. [Find more information in the university attendance policies.](#)

Online learning

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.
- If you encounter technical issues, visit the [helpdesk website](#) or call 352-392-4357.

Attendance Policy, Class Expectations, and Make-Up Policy

Attendance is required. You are expected to be aware of all announcements made in class and know all previously covered material when you attend the following class.

In general, there will be no makeup exams or assignments given. However, a student is permitted to make up a missed exam/quiz without penalty if he/she has a conflict between an exam/quiz and a scheduled University approved activity. A student needing a make-up exam or assignment due to schedule conflicts must notify the instructor at least *one week* before the day the exam or assignment is scheduled. Excused absences are consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation.

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Homework Sets (5)	100 each	40%
Project	100	30%
Exam (F2F component)	100	30%
Total		100%

Grading Policy

The following is given as an example only.

Percent	Grade	Grade Points
90.0 - 100.0	A	4.00
87.0 - 89.9	A-	3.67
84.0 - 86.9	B+	3.33
81.0 - 83.9	B	3.00
78.0 - 80.9	B-	2.67
75.0 - 79.9	C+	2.33
72.0 - 74.9	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
63.0 - 65.9	D	1.00
60.0 - 62.9	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:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

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

Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Course Evaluation

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

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 Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

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: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.

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

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.
<https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.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://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.