

Error Analyses and Optimization Methodologies in Materials Research

EMA 3800 – Section 380N – Class # 26468

Class Periods: T, Period 4 (10:40 AM - 11:30 AM) & R, Periods 4-5 (10:40 AM - 12:35 PM)

Location: CSE E222

Academic Term: Spring 2025

Instructor:

Juan Claudio Nino, jnino@ufl.edu, +1 (352) 846 3787

Office Hours: Monday & Wednesday, 10:30 – 11:30 am, 166 Rhines Hall

Teaching Assistant/Peer Mentor/Supervised Teaching Student:

Please contact through the Canvas website

- Yogesh Kumar, y.kumar@ufl.edu, Rhines Library 123 RHN, M, R 4-5 pm

Course Description

Statistical approach for materials research, basic and relevant statistical concepts, error analyses, factorial matrices, reducing the variance, nested designs and sampling plans, mixture designs, optimization technology, response surface method and Taguchi.

Course Pre-Requisites / Co-Requisites

EMA 3010 and COP 2271 (or COP 2273).

Course Objectives

Students will develop fluency with multiple methods of statistical analysis and experimental design.

Students will become comfortable with data methods in materials science: designing experiments to generate data, using code to manipulate and perform statistical tests on data, and using data to draw valid conclusions about a scientific question.

Materials and Supply Fees

None

Relation to Program Outcomes (ABET):

The table below is an example. Please consult with your department's ABET coordinator when filling this out.

Outcome	Coverage*
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	Low
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	High
7. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	Medium

*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

Required Textbooks and Software

- zyBook: [EMA 3800: Error Analyses and Optimization Methodologies in Materials Research](#)
zyBook code: UFLEMA3800NinoSpring2025
zyBook ISBN: 979-8-203-91408-8
VERY IMPORTANT – 1. Click any zyBooks assignment link in your learning management system (Do not go to the zyBooks website and create a new account). 2. Subscribe. A subscription is \$99. Students may begin subscribing on Dec 20, 2024, and the cutoff to subscribe is May 10, 2025. Subscriptions will last until June 14, 2025.
- MATLAB R2023a (or newer) by Mathworks
(Standalone Student Copy if Available) or Accessible through UF APPS - <https://portal.apps.ufl.edu/>
- Python v.3.13.1 (standalone) or through Anaconda Distribution or Miniconda - <https://docs.anaconda.com/distro-or-miniconda/>
- JupyterLab – pip installation – <https://jupyter.org/install>

Recommended Materials

- An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements
John R. Taylor
3rd Edition, ISBN: 978-1-940380-08-7
- Design and Analysis of Experiments
Douglas C. Montgomery
10th Edition, ISBN: 978-1-119816-95-9

This course will use CANVAS extensively as a communication and archival tool. Students can access all relevant course information (course notes, access to zyBooks, homework, problem sets, discussions, announcements, grades, etc.) via the CANVAS entry link: <https://elearning.ufl.edu/>

Required Computer

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

This course will require the use of a computer in almost every class session and more importantly, the exams will be taken in class using a computer. Therefore, it is required that every student has their own laptop and since there are not enough electrical outlets for everyone, the laptop's battery should last for at least 2 full hours performing calculations.

Attendance Policy, Class Expectations, and Make-Up Policy

Attendance and Participation is graded (up to 10% of the course grade) and it is strongly suggested since it is the best way to engage actively with the instructor and fellow students while the topics are being covered and get any clarifying questions answered right when they arise. In addition, a number of in class exercises totaling up to 16% of the course grade will be worked out in class.

Proper behavior during class is always important and leads to a relaxed and productive educational environment. Students who behave disorderly or disrespectfully WILL be asked to leave the classroom. Students not turning in any assignment in time will receive a grade of zero (0) and there will be no make-up for a missed exam or graded activity. Exceptions will only be entertained in cases of excused absences with proper documentation, which must comply with university policies in the undergraduate catalog Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies: <https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>

Course Schedule

Below is the intended/tentative schedule of classes, exams and activities. If there is a major scheduling conflict with the assigned dates, students should contact the instructor by the second day of classes the latest to resolve the situation. Else, it is understood that these dates stand.

Week	Date	Topics	Chapter	Pre-Class Activity	In-Class Activity	
1	Jan			Z - zyBooks	ICE = In class	
	14	Introduction - Methodology - zyBooks Scientific Method	zy 1	(due before class)	exercises	
	16	Error - Uncertainty - Propagation of Uncertainty	Taylor 1&3	Z0		
2	21	Introduction to Probability	zy 2	Z1	ICE1	
	23	Probability Distributions	zy 4			
3	28	Descriptive Statistics	zy 6	Z2		
	30	EXAM 1 (IN CLASS - CANVAS)				
4	Feb					
	4	Confidence Intervals and Hypothesis Testing - Single Sample	zy 8-9	Z3	ICE2	
6	Statistical Inference for Two Samples	zy 10				
5	11	Simple Linear Regression and Correlation	zy 11	Z4	ICE3	
	13	Design and Analysis of Single Factor Experiments	zy 13			
6	18	Analysis of Variance	zy 13	Z5	ICE4	
	20	Randomized Blocks	zy 13			
7	25	Design of Experiments with Several Factors	zy 14	Z6		
	27	EXAM 2 (IN CLASS - CANVAS)				
8	Mar					
	4	Two-Factor Factorial Experiments	zy 14	Z7	ICE5	
	6	2-k Factorial Designs	zy 14			
9	11	Blocking and Confounding	zy 14	Z8	ICE6	
	13	Response Surface Methods	zy 14			
SPRING BREAK						
10	25	Intro to Data Science - Python for Data Science	zy 19 - 20	Z9		
	27	EXAM 3 (IN CLASS - CANVAS)				
11	Apr					
	1	Data Queries - Data Wrangling	zy 22-23	Z10	ICE7	
3	Data Exploration - Regression	zy 24-25				
12	8	Evaluating Model Performance	zy 26	Z11	ICE8	
	10	Supervised Learning	zy 27			
13	15	Unsupervised Learning	zy 28	Z12		
	17	EXAM 4 (IN CLASS - CANVAS)				
14	22	Course Summary - Evaluation - Last Class Bonus - EMA 4935		Z13		
15	28	MAKE UP DURING FINAL EXAM TIME 10:00 AM- 12:00 PM (IN CLASS CANVAS)				

Important Dates

See schedule above for all important dates.

Please note that all make exams will take place during the final exam date and time allocated for this course. The exam will take place in the same classroom as during the semester.

The instructor reserves the right to make changes to the syllabus as needed. Any changes will be clearly announced on Canvas and in class.

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Exams (4; 20 points each)	Up to 80 points total	Up to 80% Maximum of 100 points
zyBooks/Labs 13, 2 points each, drop 3)	Up to 20 points total	Up to 20% Maximum of 100 points
ICEs (8, 2 points each)	Up to 16 points total*	Up to 16% Maximum of 100 points
Attendance & Participation (10 points)	Up to 10 points total	Up to 10% of 100 points
TOTAL	Up to 126 points	
NOTE that there are 126 possible total points in the course, yet grade based on a total 100-points basis as shown in the grading policy. This is essentially a built-in 26% extra credit or cushion.		

Grading Policy

The final grade of the course will be calculated based on the total points scored as follows:

Points	≥92	≥88	≥84	≥80	≥76	≥72	≥68	≥65	≥62	≥59	≥56	<56
Letter Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	E
Grade Points	4.0	3.67	3.33	3.0	2.67	2.33	2.0	1.67	1.33	1.0	0.67	0

In the event that the class average is below 72 points, the distribution will be shifted so that the average equals 72 points.

More information on UF grading policy may be found at: <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

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.ua.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.ua.ufl.edu/public-results/>.

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 Honor 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. 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.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University's core values, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

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
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu

• Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.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 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

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://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>.

**An abridged version of the Student Honor Code is presented on the next page.
The full and most up-to-date version can be found here: <https://policy.ufl.edu/regulation/4-040/>**

UNIVERSITY OF FLORIDA

Student Honor Code (Abridged)

Preamble: In adopting this Honor Code, the students of the University of Florida recognize that academic honesty and integrity are fundamental values of the University community. Students who enroll at the University commit to holding themselves and their peers to the high standard of honor required by the Honor Code. Any individual who becomes aware of a violation of the Honor Code is bound by honor to take corrective action. Student and faculty support are crucial to the success of the Honor Code. The quality of a University of Florida education is dependent upon the community acceptance and enforcement of the Honor Code.

As a result of completing the registration form at University of Florida, every student has signed the following statement:

I understand that the University of Florida expects its students to be honest in all their academic work. I agree to this commitment to academic honesty and understand that my failure to comply with this commitment may result in disciplinary action up to and including expulsion from the University.

The Honor Pledge: We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty 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."**

Violations of the Student Honor Code include (in part):

(a) **Plagiarism**, in the form of quoting oral or written materials including but not limited to those found on the internet, whether published or unpublished, without proper attribution; or submitting a document or assignment which in whole or in part is identical or substantially identical to a document or assignment not authored by the student.

(b) **Unauthorized use of Materials or Resources ("Cheating")**. A student shall not use unauthorized materials or resources in an academic activity. Unauthorized materials or resources shall include:

1. Any paper or project authored by the student and presented for the satisfaction of any academic requirement if the student previously submitted substantially the same paper or project to satisfy an academic requirement.
2. Any materials or resources prepared by another student and used without the other student's express consent or without proper attribution to the other student.
3. Any materials or resources that the faculty member has prohibited or not given EXPRESS permission to use..
4. Use of a cheat sheet when not authorized to do so or use of any other resources or materials during an examination, quiz, or other academic activity without the express permission.

(c) **Prohibited Collaboration or Consultation**. A student shall not collaborate or consult with another person on any academic activity unless the student has the express authorization.

1. Prohibited collaboration or consultation shall include but is not limited to:
 - Collaborating when not authorized to do so on an examination, take-home test, assignment, or course work.
 - Collaborating or consulting in any academic activity after receiving notice that such conduct is prohibited.
 - Looking at another student's examination or quiz during the time an examination or quiz is given. Communication by any means during that time, including but not limited to communication through text messaging, telephone, e-mail, other writing or verbally, is prohibited unless expressly authorized.
2. It is the responsibility of the student to seek clarification on whether or not use of materials or collaboration or consultation with another person is authorized prior to engaging in any act of such use, collaboration or consultation.

Other violations include (in part):

- Commissioning or seeking to commission another person or Entity, with or without compensation, to produce or complete academic work or to impersonate a student in any academic activity.
- Impersonating another person in any academic activity or providing an unfair academic advantage to another person by producing or completing academic work or activities on behalf of another person, with or without compensation.
- Complicity in Violating the Student Honor Code. Attempting, aiding, encouraging, facilitating, abetting, conspiring to commit, hiring someone else to commit, giving or receiving bribes to secure, or being a participant (by act or omission) in any act prohibited by this Regulation.
- Submission of Academic Work Purchased or Obtained from an Outside Source. A Student must not submit as their own work any academic work in any form that the Student purchased or otherwise obtained from an outside source, including but not limited to: academic work in any form generated by an Entity; academic materials in any form prepared by a commercial or individual vendor of academic materials; a collection of tests, or academic materials maintained by a Student Organization or other entity or person, or any other sources of academic work.
- Unauthorized Taking or Receipt of Materials or Resources to Gain or Provide an Improper Academic Advantage. A Student, independently or with another person or Entity or other people or Entities, must not without express written authorization take, give, possess, post, submit, transmit, or receive materials, information, or resources in any manner, through any medium, for gaining or providing an improper academic advantage to any Student.