Agricultural and Biological Engineering Department
University of Florida

Agricultural Operations Management 5435
Advanced Precision Agriculture
Fall, 2022 (Class Number 27942; Section APAG)

Catalog Description:
AOM 5435 Advanced Precision Agriculture. F. *Credits: 3. Prereq: Graduate student standing or permission of Instructor.* Principles and applications of technologies supporting precision farming and natural resource data management planning. Global positioning system (GPS), geographic information systems (GIS), variable rate technologies (VRT), data layering of independent variables, automated guidance, Internet information access, computer software management.

Prerequisite: This course is intended for graduate students in the Colleges of Agricultural and Life Sciences, Natural Resources and Environment, and Engineering. Advanced undergraduate students may take the course with the permission of the Instructor. Students should be computer literate.

Instructor: Dr. Wonsuk "Daniel" Lee
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Class Hour : M 10:40 AM – 12:35 PM (4th-5th periods), Frazier Rogers Hall Room 211.

Laboratory Hour: W 10:40 AM – 12:35 PM (4th-5th periods), Frazier Rogers Hall Room 211/282, and various other locations.

Course homepage: https://elearning.ufl.edu. Course lecture notes, lab handouts, and other related materials will be available on the course website.

Office Hours: My door is *always* open to students at any time. You are welcome to visit me whenever I am available or by appointment.

Text: *The Precision-Farming Guide for Agriculturists*, by Morgan and Ess, Deere & Company, **2017**. **4th Edition (ISBN: 0-86691-435-8,** John Deere Publishing: 1-800-522-7448, Order no. FP404NC, On-line: https://techpubs.deere.com/en/Search/Education).

Course Objectives: This course covers information and technologies that are used for precision farming and their applications. In this course, we would like to:
1. Describe what precision agriculture is and why it is needed,
2. Explain the principles and applications of the Global Navigation Satellite System (GNSS),
3. Describe what a yield monitoring system is,
4. Identify current remote sensing technologies,
5. Become familiar with GIS (Geographic Information Systems) software and be able to utilize it,
6. Explore principles and applications of variable rate technologies (VRT),
7. Be able to identify sensing technology for precision agriculture,
8. Become familiar with the history of artificial intelligence and its applications in agriculture, and
9. Apply precision agriculture to an actual situation.

After learning these technologies, if time permits, more in-depth topics will be covered, such as yield calculation and yield map generation, soil property measurements (spectrometer and other devices), comparison of yield and soil test results, sensors for site-specific application, VRT system calibration and map generation based on recommended equations, economics, and profitability of precision agriculture, development of site-specific management plans, etc.

Course grading will be based on the following items:

1. **Attendance** at lectures and laboratory exercises is required.

2. **Tests:** There will be two (2) tests. There will <u>not</u> be a comprehensive final examination. Tests will help review course materials and achieve course objectives. The test problems will be similar to those in the homework and quizzes.

3. **Homework** will be available on the course website after each chapter, only for the self-study purpose, and will <u>not</u> be submitted <u>nor</u> graded. These will be extremely useful for preparing quizzes and tests.

4. **Quizzes** will be given every two weeks on Mondays during the semester, starting **September 12**. The quiz problems are from the previous two week's lectures, lab exercises, and/or homework. Quizzes will help you study course materials and achieve course objectives. Quizzes are given at the end of the class. <u>Quizzes cannot be made up.</u>

5. **Laboratory assignments** will be handed out for every laboratory session. They will help you better understand the goals of lab exercises and facilitate opportunities to work on various precision technologies. Lab assignments should be submitted in the E-Learning. Lab assignments are due at the beginning of the class.

6. **Journal article review:** After we finish one lecture, you will find a published journal article related to the lecture topic, write a summary, and submit it to E-Learning. The review will help you understand the current status and application of the technology.

7. **Term project:** You will work on a <u>hands-on</u> project related to the topics in this course during the semester, which will give you experience in implementing technologies. Example project topics are listed at the end of this syllabus. You will present your project near the end of the semester. The following are important due dates.

   1) Project outline: Monday, September 19 (50 pts) – Title, significance, and objectives.
   2) Progress report: Monday, October 17 (75 pts) – Up to "Materials and Methods" in Coversheet along with revised title, significance, and objectives.
   3) Final written report: Monday, November 21 (75 pts) – Full report with the Coversheet
   4) Presentation: Wednesday, November 30 (25 pts)

8. **All assignments should be submitted in the E-Learning. You will need to submit them at least a few minutes earlier than class time so that you can come to class on time.** Email submissions will <u>NOT</u> be accepted.

9. **Late submission policy:** <u>All assignments are due at the beginning of the class</u>. Thereafter a 10% reduction per business day.

Grading will be based on the following items and weights:

Test 1 (**Oct. 12**):	15%	91.0 – 100%	A	72.0 – 75.9%	C
Test 2 (**Dec. 7**):	15%	89.0 – 90.9%	A-	69.0 – 71.9%	C-
Quiz:	15%	86.0 – 88.9%	B+	66.0 – 68.9%	D+
Lab assignment:	15%	83.0 – 85.9%	B	62.0 – 65.9%	D
Journal article review:	10%	80.0 – 82.9%	B-	59.0 – 61.9%	D-
Term Project:	30%	76.0 – 79.9%	C+	Below 59.0%	E

Grades and Grade Points: For information on current UF policies for assigning grade points, see
https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/.

Attendance and Make-Up Work: Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at:
https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/.

Services for Students with Disabilities: Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center. Click here to get started with the Disability Resource Center. 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.

Online Course Evaluation Process: 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.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

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.

Academic Honesty: 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 specifies a number of behaviors that are in violation of this code and the possible sanctions. Click here to read the Honor Code. 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.

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.

Canvas Technology Requirements: Computers, Internet, and Web browsers: Canvas runs on Windows, Mac, Linux, iOS, Android, or any other device with a modern web browser. It is recommended to use a computer less than five years old with at least 1GB of RAM. It is recommended to have a minimum Internet speed of 512kbps. It is **strongly recommended** to not use a wireless connection, phone, tablet, or notepad for critical course tasks such as exams and discussions.

Canvas currently supports the following browsers: Chrome, Safari, Firefox, Edge. Canvas supports the last two versions of most browsers. It is **highly recommend** updating to the newest version of whatever browser you are using. Note that your computer's operating system may affect browser function. Failure to use one of these browsers will cause problems.

For more information on approved computers and browsers please visit: https://community.canvaslms.com/t5/Canvas-Basics-Guide/What-are-the-browser-and-computer-requirements-for-Canvas/ta-p/66. On this web page there is an area titled "Is My Browser up to Date?" Use it to check each computer and browser you may use in this course. There is another important area on "Browser Privacy Settings." Read the section(s) for any browser intended for use. For example, **Note that**: In browsers such as Safari, insecure content will never be displayed in the browser. Return to the page to check for updates on technology issues in Canvas.

If you encounter technical difficulties in this course, **contact the UF Computing Help Desk** right away to troubleshoot. https://helpdesk.ufl.edu/ or (352) 392-HELP. If the problem cannot be fixed immediately, **notify your instructor, and provide them with the Help Desk ticket number.**

Campus Resources: Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources.

Health and Wellness
- *U Matter, We Care*: If you or someone you know is in distress, please contact umatter@ufl.edu, 352-392-1575, or visit U Matter, We Care website to refer or report a concern and a team member will reach out to the student in distress.
- *Counseling and Wellness Center*: Visit the Counseling and Wellness Center website or call 352-392-1575 for information on crisis services as well as non-crisis services.
- *Student Health Care Center*: Call 352-392-1161 for 24/7 information to help you find the care you need, or visit the Student Health Care Center website.
- *University Police Department*: Visit UF Police Department website or call 352-392-1111 (or 9-1-1 for emergencies).
- *UF Health Shands Emergency Room / Trauma Center:* For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608; Visit the UF Health Emergency Room and Trauma Center website
- *GatorWell Health Promotion Services*: For prevention services focused on optimal wellbeing, including Wellness Coaching for Academic Success, visit the GatorWell website or call 352-273-4450.

Academic Resources
- *E-learning technical support*: Contact the UF Computing Help Desk at 352-392-4357 or via e-mail at helpdesk@ufl.edu.
- *Career Connections Center*: Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services.
- *Library Support*: Various ways to receive assistance with respect to using the libraries or finding resources.
- *Teaching Center*: Broward Hall, 352-392-2010 or to make an appointment 352- 392-6420. General study skills and tutoring.
- *Writing Studio:* 2215 Turlington Hall, 352-846-1138. Help brainstorming, formatting, and writing papers.
- *Career Resource Center*, First Floor JWRU, 392-1601, https://career.ufl.edu/.

- Student Complaints On-*Campus*: Visit the Student Honor Code and Student Conduct Code webpage for more information
- On-line Students Complaints: View the Distance Learning Student Complaint Process.

AOM 5435 Term Project

- Use the Coversheet as a guideline for your reports. The Coversheet is available in E-Learning.
- Attach the Coversheet for all your report submissions.

Project Topics
- Identify your interests and consult with me to decide on your project
- The project should be an in-depth and hands-on application of one or more tools in precision agriculture.
- Examples include an artificial intelligence application to agriculture, GNSS and GIS applications, big data analysis, IoT, wireless technology, case study, cost/benefit analysis, literature review for field sensors (for yield, nutrient, and water), etc.

Previous Topics
- Remote sensing imagery classification: supervised vs. unsupervised → performance comparison
- Silage moisture sensor: tried TDR for a potential moisture sensor for silage
- Investigation of input and output for a mini farm: boundary mapping, soil sampling, nutrient analysis, create GIS layers, harvest, and compare inputs vs. yield
- Economic benefits of precision agriculture to growers: obtained data from commercial growers, review of the Income Statements and cost/benefit analysis for using Precision Ag over traditional management practices
- Comparison of different interpolation methods using soil data
- Soil variability in time domain (rather than spatial variability)
- Precision irrigation using wireless network and soil water sensors
- Robotic sprayer for nursery plants
- Citrus grove management using precision technologies
- A review on citrus disease detection based on remote sensing
- Soil mapping for studying soil properties
- Simulation of precision irrigation based on GPS navigation
- Management zones to apply site-specific fertilization
- Managing agrochemical application in citrus grove using two variable rate technologies
- A laser weeding demonstration system
- Green citrus detection in natural canopies using eigenfruit, color, and circular Gabor texture features
- Model photosensor system to calculate the volume of the flow grain (wheat & peas)
- A study of sensors and methods useful for crop and tree characteristics
- Use of UAVs in precision agriculture – case studies
- Detection of apple disease using hyperspectral imaging
- Tomato leaves gray mold detection using hyperspectral imaging
- Citrus black spot detection based on selected wavelengths using hyperspectral images
- A guide to instantaneous yield monitoring components for grains and cotton
- Developing a Weed Detection Algorithm Using Machine Vision
- Mapping and Remote Evaluation for Small Plot Fungicide Trials
- Detecting two-spotted spider mite in strawberries using deep learning and spatial interpolation methods
- Modeling cover crop soil coverage using close-range high-resolution images
- Irrigation recommendations for On Top of the World (OTOW), Ocala based on current soil conditions and treatments
- Assessment of morphological parameters in young citrus trees using multispectral imaging

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Coversheet of Term Project

Name _____ **Score:** _____

_____ (04) Title – reflects work well, clear, and meaningful

_____ (10) Abstract or Summary
  _____ (04) Clarity and brief overview
  _____ (04) Inclusion of all components of the whole paper
  _____ (02) Organization and well written

_____ (10) Significance of the problem
  _____ (04) Scientific and engineering significance
  _____ (04) Social and economic significance
  _____ (02) Significance supported by citations and current problem

_____ (10) Objectives
  _____ (05) Clearly and specifically stated
  _____ (05) Supported by background information

_____ (10) Background and Literature Review
  _____ (04) Relevant citations, clear relationship with your current research
  _____ (04) List most up-to-date articles
  _____ (02) Organization and well written

_____ (10) Materials and Methods
  _____ (04) Proper materials used
  _____ (04) Logical and scientifically sound methods carried out
  _____ (02) Organization and well written

_____ (10) Results and Discussion
  _____ (08) Logically drawn and thoughtfully explained
  _____ (02) Organization and well written

_____ (05) Conclusion

_____ (06) References

_____ (25) Presentation
  _____ (08) Visual aids – Nicely made and well organized
  _____ (08) Well explained, proper presentation of work
  _____ (05) Voice – clear and loud enough
  _____ (04) Finish on time (15 min.)