Partnering With Industry (MATH 492)
Mathematics Applications in Industry and Government (MATH 490)

(This course is open to math majors with instructor permission to enroll and is made available through funding by PICMath DMS-1722275)

	LCSC	WSU
Time	TTh 10:35–11:45	TTh 10:35–11:45
Location	MLH 220	Daggy Hall 226
Credits	3	3
Instructor	Dr. Heather Moon	Dr. Tom Asaki
Office Hours	TBD	TBD

Course Description

This course is an exploration in applied mathematics in which students spend the semester in a small collaborative team tackling a current research problem provided by an industry or government client. The content knowledge of the course is determined by the methods needed in order to tackle the problems under investigation. As a team you may need tools such as modeling, data analysis, computer programming, linear algebra, differential equations, optimization, and statistics. Students will develop, test and implement mathematical models of their own devising, performing calculations and evaluate their results for accuracy and appropriateness. The main objective of the course is that each student, while working in a classroom setting, will experience how math is done in the real world, developing collaboration skills by working in small teams towards a common goal and improving mathematical and technical communication skills. Teams will be composed of 3 or 4 students working in collaboration with an industry/government client and composed of a combination of students from both Washington State University and Lewis-Clark State College. At the end of the course, each group will complete a formal written report and recorded video presentation, and provide a technical presentation to their client.

This course is intended for upper-division students with a strong desire to explore applied mathematics. Course prerequisites include completion of Calculus II and at least concurrent enrollment in Calculus III, or permission of the instructor. Completion of additional mathematics courses (e.g. linear algebra, differential equations, mathematical modeling, mathematical programming, etc.) is recommended but not required.

This course was developed with the support of the PIC Math program (Preparation for Industrial Careers in Mathematics), sponsored by the Mathematical Association of America (MAA), the Society for Industrial and Applied Mathematics (SIAM), and the National Science Foundation (NSF). Goals of the PIC Math program are to engage math majors in industrial research, prepare them for industrial careers, and expose students to problems outside of academia which are mathematical in nature.

Course Details

View your course experience as an employee of a consulting firm. As a group, we meet twice weekly in a working meeting. The company directors (Heather and Tom) make company decisions and assist with the detail work. You, the students, work in small teams that develop and apply mathematical tools to answer client (business partner) questions. Our clients employ us to provide meaningful answers to their business and science questions.

Classroom Activities

1. On the first day of class, Tuesday January 8, our partners will be in the classroom (either at LCSC or at WSU) to present their research questions. You will be assigned to a working team and given your semester assignment.

2. Class time will be reserved primarily for small team collaborative work. During these sessions, teams have an opportunity to get feedback from both professors as well. As some teams will have a combination of WSU and LCSC students, individual teams should arrange to be able to meet during class time using video.

3. *Every* student should be prepared *at any time* to provide a 3–5 minute progress report on behalf of their team.

4. Class periods at midterms and at the end of the semester will be reserved for in-class presentations. These presentations will be described in the Formal Presentations section.

Collaboration

5. Each team is expected to meet regularly outside of class time to collaborate on their project.

6. As this is a team project, every team member should be aware of the team's activities leading toward the solution. It is likely that tasks will be split up among members of the team. So, regular updates and contact with your team members is a must. All email correspondence with our business partners should first be checked by *both* professors.

7. Teams can request mathematical assistance from both professors. The team should not expect the professors to direct the team effort or dictate the use of specific mathematical tools. Rather, the professors will offer feedback on methods and approaches devised by the students.

Written Reports and Abstracts

8. At midterm, every team will turn in a mid-term report that includes (but is not limited to) the following key points.

   (a) Introduction: Partnering organization description, problem statement

   (b) Problem: description (including definitions detailing when a solution is found), plan for solution method (are there resources that suggest this is a good plan?).

   (c) Data: Description of data

   (d) Methodology: What methods are you using? What do you expect to gain from these methods and why do you think it will work?

   (e) Experimentation: Try your methodology on smaller pieces of data. What can you predict about the ability of this method in finding a solution?

   (f) Plan to finish the problem, what will you complete? What might you not complete and why not?

   The grade for your midterm report will be based on content (all the required points above) and readability – both from mathematical and non-mathematical viewpoints. Feedback will be given to assist in crafting a more professional report before submission to your client organization.

9. Each team will submit a proposal for a talk to be given at MathFest (which takes place in August in Cincinnati). The due date for this is 2 weeks prior to the due date given by Mathfest (likely mid-April) to give us time to provide feedback before submission.

10. A final written report for each team is due May 3rd. A draft may be submitted a week early for feedback. The final report will be given to your client as well so it should address all questions your client asks at your final presentation along with the following components.

    (a) An executive summary. If your boss has three minutes to read your report, what is the most important information you can provide her or him? In the quick three-minute read, the client should know to whom in the organization s/he will hand the report for a thorough reading.

    (b) Introduction: client organization description, problem statement.

    (c) Problem: description (including definitions detailing when a solution is found), plan for solution method (are there resources that suggest this is a good plan?). Description of your data.

    (d) Methodology: What methods are you using? What do you expect to gain from these methods and a description of the experimentation that suggests this was a good method to use.

    (e) A complete solution describing why you believe the solution is a good solution.

    (f) Conclusion and future work: The results of what you found. This is the short description that clearly describes what you found. To further answer questions for your client, what more can or will you do? It may be that further work on your project turns into a summer research project. What can you do in the summer to continue helping your client organization with the data they provided?

    You grade for the final report will be based on content, clarity, professionalism, and your response to the client's question.

Formal Presentations

11. March 14th will be devoted to midterm presentations. The presentation will be a 12-minute report (with time after for questions) outlining your problem, the team's status on the problem, any hurdles or difficulties, and mostly a good practice for your upcoming reports. Feedback will be given about presentation material and ideas for improving presentation style. A beamer template will be available for any team needing assistance in creating a presentation in LaTeX.

12. April 25th will be devoted to final presentations. Clients will be in class to hear your presentations and ask questions about your solutions. Your final presentations will be 12 minute long presentations (with time after for questions) providing a description of the problem, a brief description of the solution technique (given in a way that is clear for your client), and the results of your work.

Your presentation should include many figures that clearly show your results in flashy way for your client.

13. For any team whose talk proposal is accepted you will present a MathFest talk. At least one team from each school will also present a poster for PICMath at MathFest. These presentations will be in August. If you cannot make the trip to MathFest in August because of scheduling constraints, we need to know right away. You will not be expected to fund your own trip to MathFest – we will be working on providing travel funds for as many students as possible.

Expectations for Collaboration and Conduct

14. Teams should fully collaborate. At times parts of teams may meet, but whenever possible all members should be present at meetings. All team members should be updated on any progress made. (See #3 above.)

15. All communication between team members should be professional and respectful. Each student is in this class because we have evidence that they can contribute something significant to each problem.

16. There will be several concurrent team meetings happening during each class period. During this time, teams should stay on task and not become a distraction to other groups.

17. Communication with clients should be formal. Though students may have more expertise, mathematically, clients are the experts in their organization. Students should recognize the expertise in their client and use this expertise to gain a better understanding of the problem and the type of solution being sought after. Clarity in communication with the client is key to communicating professionally. Know your audience and do not try to discuss minute details that are unnecessary for the client's understanding of your solution.

Student Evaluation

While we would like to simply focus on the interesting mathematics, we must be mindful that you are taking a mathematics course for credit at LCSC or at WSU. So, we need to discuss how your performance will be evaluated and how your course grade will be assigned. Your performance will be measured similarly to how it might be evaluated in an employment scenario. Your professors are the company directors, you are an employee assigned to work on a team to complete a project for a client. Here is what the company directors will be considering when evaluating you, the employee:

- Are you a team player? Do your teammates feel respected by your communication and participation?
- Did you make a clear effort to understand and solve the client's questions? Did you give a marked contribution toward the problem solution?
- Did your skills and creativity contribute to the team effort? Were you active in producing concrete results?
- Did your results display significant and appropriate mathematical content? Did you justify your methodology? Were your tools/methods appropriate and were they used correctly? Did your tools advance your mathematical knowledge?
- Were you able to communicate professionally? Did you proofread? Were your writing and presentations audience appropriate? Did you treat others with respect? Did you use the correct mathematical notation, terminology, and formatting?

Each of the above will be given a rating of "Obviously Met Expectations," "Mostly Met Expectations," or "Did Not Meet Expectations." You grade will be as follows:

		#of Mostly Met					
		5	4	3	2	1	0
#of Obviously Met	5	-	-	-	-	-	A
	4	-	-	-	-	A	A-
	3	-	-	-	B	B-	C
	2	-	-	B	B-	C	C-
	1	-	C	C-	D	D	F
	0	C	C-	D	D	F	F

Though, we must give a grade criteria as above, we believe that anyone taking the time to enjoy the problem, the work involved, and learning, will obviously meet expectations in all areas. We also believe that one question that will arise in many students' minds is **"What if we do not or cannot answer the client question?"** This is a valid question, but is also not the main goal here. Some questions cannot be easily answered (completely), but there is always something that can be learned. It is not a failure to not complete the task. In these cases, students should be able to present what they know, how they attempted the problem, what they can answer (or what was found), and why the problem solution is not (easily) attainable. Here communication is key. Teams, in this case, will know what future work should be explored and can present this as well.

To evaluate the above, we will use the following tools.

- We will give a team dynamics survey to each student. (See document on collaboration.)
- We will request feedback from clients. (See document on collaboration.)
- We will observe team dynamics in meetings and in classroom activities. (See document on collaboration.)
- Students will give "daily reports." (See #3 above.)
- Teams will submit two written reports. (See #8 and #10 above.)
- Teams will submit a talk proposal to MathFest. (See #9 above.)
- Teams will make two presentations. (See #11 and #12 above.)
- Email communication with professors and clients will be evaluated. (See document on collaboration.)

Academic Integrity

In addition to academic integrity policies specifically stipulated by LCSC and WSU, you should be aware of course-specific policies outlined here. Plagiarism is typcally associated with written works such as essays, stories, reports, etc. However, you should be aware that mathematics research is very much subject to unethical conduct such as plagiarism.

> "Plagiarism: (n) an act or instance of using or closely imitating the language and thoughts of another author without authorization and the representation of that author's work as one's own, as by not crediting the original author." [https://www.dictionary.com/browse/plagiarism]

The guiding principle is:

> ***Always give credit where credit is due. Never claim that, or give the impression that, someone else's ideas, work or results are your own.***

In order to better understand how this principle is revealed in mathematical research, consider the following examples.

- Your team discovered a research paper in which the authors used a data analysis technique that is very beneficial to your own work. You use this technique and report your results. You should cite the research paper as a source of the method. You should be careful to use citations in reports and presentations. And, you should be careful to acknowledge the paper even in conversation with others outside of your team.

- Your team's research was assisted by a key conversation with your instructor or other classmate. You should clearly acknowledge this conversation, both in reports and presentations.

- Your team's data analysis was inspired by two research papers that you found online. Your work was different from that given by other researchers. You should be careful to cite the other researchers, acknowledging their contribution to your own results and provide a discussion on similarities and differences of the methods.

- At one point in your data analysis, you used a linear least squares method to fit a line to a data set. You need not seek out a reference to cite because this method is understood to be commonly used and well-established for the given task.

- Your team decides to use a technique you learned in another course. You should both use proper citations for the method (original research papers) and acknowledge the course as a source of inspiration. In particular, you can discuss how the method was used in the other course and how it is applicable to your current research.

- You are a team and you are co-authors of your work. You do not need to credit individual team members for their specific contributions to the research. The exception to this rule is when in conversation – you would not want to give the impression that as an individual you completed all aspects of the team's research.

- You used mathematical methods similar to (or the same as) methods you used in your own previous research. You should cite your previous research paper.

- Your research used data which you obtained from your client. You must cite the original source of the data or use a client-suggested citation.

WSU-Specific Policies

Students with Disabilities

Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please either visit or call your campus resource to schedule an appointment. All accommodations MUST be approved through the campus resource. For more information contact a Disability Specialist on your campus: 509-335-3417, Washington Building 217, Access.Center@wsu.edu, accesscenter.wsu.edu

Academic Integrity

Academic integrity is the cornerstone of higher education. As such, all members of the university community share responsibility for maintaining and promoting the principles of integrity in all activities, including academic integrity and honest scholarship. Academic integrity will be strongly enforced in this course. Students who violate WSUs Academic Integrity Policy (identified in Washington Administrative Code (WAC) 504-26-010(3) and -404) will receive a failing grade for the assignment and possibly for the course, will not have the option to withdraw from the course pending an appeal, and will be reported to the Office of Student Conduct. Cheating includes, but is not limited to, plagiarism and unauthorized collaboration as defined in the Standards of Conduct for Students, WAC 504-26-010(3). You need to read and understand all of the definitions of cheating: http://app.leg.wa.gov/WAC/default.aspx?cite=504-26-010. If you have any questions about what is and is not allowed in this course, you should ask course instructors before proceeding. If you wish to appeal a faculty member's decision relating to academic integrity, please use the form available at conduct.wsu.edu.

Safety and Emergency Notification

Classroom and campus safety are of paramount importance at Washington State University, and are the shared responsibility of the entire campus population. WSU urges students to follow the "Alert, Assess, Act," protocol for all types of emergencies and the "Run, Hide, Fight" response for an active shooter incident. Remain ALERT (through direct observation or emergency notification), ASSESS your specific situation, and ACT in the most appropriate way to assure your own safety (and the safety of others if you are able). Please sign up for emergency alerts on your account at MyWSU. For more information on this subject, campus safety, and related topics, please view the FBIs Run, Hide, Fight video and visit the classroom safety page provost.wsu.edu/classroom-safety.