# Problem Solving
## Point Loma Nazarene University, Spring 2023

| **Instructor:** Kyle Havens | **Course:** Math 3003 | **Section:** 1 & 2 | **Units:** 3 |
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| **Office:** Rohr Science 276 | **Classroom:** LS 203 | **Time s1:** 1-2:15pm | **Time s2:** 2:30-3:45pm |
| **Email:** kylehavens@pointloma.edu | **Days:** Tues., Thurs. | **Zoom:** https://pointloma.zoom.us/my/khavens2 | |

**Required Materials:**
1. eText & MyLab Access: *Excursions in Modern Mathematics,* 10th Edition by Tannenbaum (ISBN: 8220126426948)
2. Calculator (any scientific or graphing calculator is adequate)

**Prerequisite:** A passing grade in Math 0099 or equivalent.

**Office Hours:** Monday, Wednesday and Friday: 7:15-8:15am in RS276, Monday: 12-3pm by appointment only, Tuesday: 8:30-9:30am in Zoom, Tues/Thurs: specific afternoons in Zoom.

**Course Description:** A foundational exploration course whose major goal is to develop the ability to solve non-routine problems through dynamic processes of inquiry and exploration, logical reasoning, making and testing conjectures and investigating implications of conclusions. A study of quantitative reasoning with emphasis on active problem solving and developing connections with other disciplines. Not applicable toward a major in Mathematics.

**Student Learning Outcomes:** Upon completion of this course:
1. Students will be able to formulate a mathematical model from a verbal description of a problem.
2. Students will be able to solve non-routine problems using logic and quantitative techniques.
3. Students will be able to construct solutions to problems using computational techniques

**Foundational Exploration:** This is a PLNU Foundational Explorations course (a general education course).
PLNU provides a foundational course of study in the liberal arts informed by the life, death, and resurrection of Jesus Christ. In keeping with the Wesleyan tradition, the curriculum equips students with a broad range of knowledge and skills within and across disciplines to enrich major study, lifelong learning, and vocational service as Christ-like participants in the world's diverse societies and cultures. This course is one of the components of the General Education Program at Point Loma Nazarene University, in support of the general education learning outcome: Quantitative Reasoning: Students will be able to solve problems that are quantitative in nature. The purpose of general education is to provide a common educational experience, to develop essential skills, and to provide a broad cultural background for personal and professional growth.

**Foundational Explorations Learning Outcomes:**
1. Students will be able to solve problems that are quantitative in nature.
2. Students will be able to formulate a mathematical model from a verbal description of a problem.
3. Students will be able to solve non-routine problems using logic and quantitative techniques.
4. Students will be able to construct solutions to problems using computational techniques

**University Mission – Teach, Shape, Send:** Point Loma Nazarene University exists to provide higher education in a vital Christian community where minds are engaged and challenged, character is modeled and formed, and service is an expression of faith. Being of Wesleyan heritage, we strive to be a learning community where grace is foundational, truth is pursued, and holiness is a way of life.

**Department Mission:** The Mathematical, Information, and Computer Sciences department at Point Loma Nazarene University is committed to maintaining a curriculum that provides its students with the tools to be productive, the passion to continue learning, and Christian perspectives to provide a basis for making sound value judgments.

**Class Performance:** Your final grade in my class will be calculated with the following weighting system.

| | | |
|---|---|---|
| 25% | Final Exam | All problem-solving students take the same cumulative final. |
| 40% | Exam Average | The average score of your 2 in-class exams. |
| 10% | Online Homework | Completed online using MyLab and Mastering |
| 5% | Online Quizzes | Completed online using MyLab and Mastering |
| 8% | Written Homework | Traditional homework from the textbook assigned weekly. |
| 5% | Group Project | A larger-scale problem to be solved with classmates. |
| 5% | Individual Budget Project | An individual project in Excel to plan a future budget. |
| 2% | Participation | Based on in-person and lab attendance. |

**Letter Grade**: The letter grade you receive will be based on your total score from the above system.

| | | |
|---|---|---|
| Above 92%: A | 82-87%: B | 70-77%: C |
| 90-91%: A- | 80-81%: B- | 68-69%: C- |
| 88-89%: B+ | 78-79%: C+ | 60-67%: D |

The grade you receive at the end of the semester will be the grade you earned based on the grading system. All requests for an opportunity to improve your grade due to personal circumstances will be denied. Borderline grades may be rounded up if student has good attendance.

**Final Exam:** The final exam is cumulative, is not curved, and will be held at the following time:

**Friday, May 5th from 4:30pm to 7:00pm.**

**Final Exam:** The final exam date and time is set by the university at the beginning of the semester and may not be changed by the instructor. This schedule can be found on the university website and in the course calendar. No requests for early examinations will be approved. Only in the case that a student is required to take three exams during the same day of finals week, is an instructor authorized to consider changing the exam date and time for that particular student.

**Online Homework/Quizzes:** Online assignments (online homework and quizzes) will be completed in MyLab and Mastering website. This will be available by purchasing an access code. The online homework is typically due 5-10 days after covering the topic in class. One section of homework will be assigned for each section covered in class, consisting of anywhere between five to twenty problems (depending on problem length and difficulty). You are responsible for keeping up with the online homework. You will have online quizzes in MyLab and Mastering in addition to homework. The design is for you to first complete the online and written homework for each chapter and then to attempt the quiz. The quizzes are timed and more restricted than the homework.

**Written Homework:** Written homework will always be posted on Canvas and will be submitted online in Canvas. The problems are to be done by hand and are assigned from your textbook. The due dates will be posted in Canvas, but typically you will have at least one week to complete the assignments from a chapter after it is covered in class. Each written problem set will consist of approximately five questions. Each problem will be graded for correctness by a student grader. Late homework is not accepted without a well-documented emergency. Please be sure that written assignments are legible and organized. You are responsible for ensuring your submissions can be viewed by the grader. If your submission is illegible or causes an error you will be marked late. I encourage you to work together on your homework, but directly copying another student's homework is considered plagiarism and will not be tolerated.

**Exams:** There will be a total of three normal exams every four to five weeks of the semester. You may be allowed to use a small page of notes on the exams. Make-up exams are allowed without express consent. Contact me **before** missing exam if you have a critical emergency. If you do not inform me that you will be missing an exam beforehand, you will get a zero on that exam. Exams are weighted equally at 20% of your total grade. If you have good attendance throughout the semester (no more than one unexcused absence), I will adjust the weighted scale of the exams in your favor, 25% for the highest exam and 15% for the lowest. Practice exams will be posted on Canvas in advance of the exam designed to help you identify questions that you need to study further.

**Participation**:  Mathematics requires active participation. Participation means: asking questions, making conjectures and checking them, providing solutions to problems, sharing ideas with classmates. During class time we collectively will participate in the same way. I will act as the expert facilitator during class time, with a mixture of lecture, group problem solving, and integrated discussion. You will receive points for each class attended by using the sign-in sheet.

| | |
|---|---|
| Online Quizzes | 15.00 |
| Online Homework | 25.00 |
| Written Group Homework | 15.00 |
| Reading Text | 15.00 |
| Watching Videos | 25.00 |
| Group Project | 4.00 |
| Budget Project | 3.00 |
| Chapter Post Test Reviews | 15.00 |
| Midterms | 2.50 |
| Final Exam | 1.00 |
| TOTAL | 120.50 |

**Credit Hour:**  In the interest of providing sufficient time to accomplish the stated course learning outcomes, this class meets the PLNU credit hour policy for a 3-unit class delivered over 15 weeks. Specific details about how the class meets the credit hour is provided to the right.

**Attendance:**  Attendance is expected at each class session. In the event of an absence, you are responsible for the material covered in class and the assignments given that day. Regular and punctual attendance at all classes is considered essential to optimum academic achievement. If the student is absent from more than 10 percent of class meetings, the faculty member can file a written report which may result in de-enrollment. If the absences exceed 20 percent, the student may be de-enrolled without notice until the university drop date or, after that date, receive the appropriate grade for their work and participation. See Academic Policies for further information about class attendance.

In some courses, a portion of the credit hour content will be delivered asynchronously and attendance will be determined by submitting the assignments by the posted due dates. See Academic Policies in the Undergraduate Academic Catalog.  If absences exceed these limits but are due to university excused health issues, an exception will be granted.

> ***Asynchronous Attendance/Participation Definition:***
> A day of attendance in asynchronous content is determined as contributing a substantive note, assignment, discussion, or submission by the posted due date. Failure to meet these standards will result in an absence for that day. Instructors will determine how many asynchronous attendance days are required each week.

**Use of Technology:**  In order to be successful in the online or hybrid environment, you'll need to meet the minimum technology and system requirements; please refer to the Technology and System Requirements information. Additionally, students are required to have headphone speakers, microphone, or webcams compatible with their computer available to use. Please note that any course with online proctored exams require a computer with a camera (tablets are not compatible) to complete exams online. Problems with technology do not relieve you of the responsibility of participating, turning in your assignments, or completing your class work.

**Class Enrollment:**  It is the student's responsibility to maintain his/her class schedule. Should the need arise to drop this course (personal emergencies, poor performance, etc.), the student has the responsibility to follow through (provided the drop date meets the stated calendar deadline established by the university), not the instructor. Simply ceasing to attend this course or failing to follow through to arrange for a change of registration (drop/add) may easily result in a grade of F on the official transcript.

**Spiritual Care:**  Please be aware PLNU strives to be a place where you grow as whole persons. To this end, we provide resources for our students to encounter God and grow in their Christian faith.  If students have questions, a desire to meet with the chaplain or have prayer requests you can contact the Office of Spiritual Development.

**Copyright Policy:**  Point Loma Nazarene University, as a non-profit educational institution, is entitled by law to use materials protected by the US Copyright Act for classroom education. Any use of those materials outside the class may violate the law.

**State Authorization:**  State authorization is a formal determination by a state that Point Loma Nazarene University is approved to conduct activities regulated by that state. In certain states outside California, Point Loma Nazarene University is not authorized to enroll online (distance education) students.  If a student moves to another state after admission to the program and/or enrollment in an online course, continuation within the program and/or course will depend on whether Point Loma Nazarene University is authorized to offer distance education courses in that state.  It is the student's responsibility to notify the institution of any change in his or her physical location.  Refer to the map on State Authorization to view which states allow online (distance education) outside of California.

**Academic Honesty:**  Students should demonstrate academic honesty by doing original work and by giving appropriate credit to the ideas of others. Academic dishonesty is the act of presenting information, ideas, and/or concepts as one's own when in reality they are the results of another person's creativity and effort. A faculty member who believes a situation involving academic dishonesty has been detected may assign a failing grade for that assignment or examination, or, depending on the seriousness of the offense, for the course. Faculty should follow and students may appeal using the procedure in the university Catalog. See Academic Policies for definitions of kinds of academic dishonesty and for further policy information.

**Academic Accommodations:** PLNU is committed to providing equal opportunity for participation in all its programs, services, and activities. Students with disabilities may request course-related accommodations by contacting the Educational Access Center (EAC), located in the Bond Academic Center (EAC@pointloma.edu or 619-849-2486). Once a student's eligibility for an accommodation has been determined, the EAC will issue an academic accommodation plan ("AP") to all faculty who teach courses in which the student is enrolled each semester. PLNU highly recommends that students speak with their professors during the first two weeks of each semester/term about the implementation of their AP in that particular course and/or if they do not wish to utilize some or all of the elements of their AP in that course. Students who need accommodations for a disability should contact the EAC as early as possible (i.e., ideally before the beginning of the semester) to assure appropriate accommodations can be provided. It is the student's responsibility to make the first contact with the EAC.

**Course Philosophy:** The general method of the course is to involve students in "dynamic processes of inquiry and exploration, logical reasoning, making and testing conjectures, and investigating implications of conclusions" [Catalog]. Specifically, the focus is on the processes and tools of quantitative problem solving. Learning what they are and developing ability to use them.

- "Today's world is more mathematical than yesterday's, and tomorrow's world will be more mathematical than today's."
- "...mathematics...serves as a key to opportunity and careers." [Everybody Counts, p.45, p.3]
- "To participate rationally in a world where discussions about everything from finance to the environment, from personal health to politics, are increasingly informed by mathematics, one must understand mathematical methods and concepts, their assumptions and implications." [50 Hours, p.35]

In view of these statements and many other similar ones from national reports, this quantitative experience (MTH 303) has been included as part of the PLNU general education curriculum. Thus, all students will study "major concepts, methods, and applications of quantitative reasoning with emphases on active problem solving" [Catalog].

## Course Approach:
The ability to solve problems requires resourcefulness, flexibility, and efficiency in dealing with new obstacles. Research on teaching and learning problem solving suggests that certain factors are critical to successful problem solving, including resources, heuristics, control, and belief systems [Schoenfeld, 1985].

1. Resources refer to whatever information problem solvers understand (or misunderstand) that might be brought to bear on a problem.
2. Heuristic refers to strategies and techniques problem solvers have (or lack) for making progress when working on non-routine problems.
3. Control refers to the way problem solvers use (or fail to use) the information at their disposal.
4. Belief systems refer to the problem solver's "world view" of the problem domain, which determines the ways they use the knowledge in the first three categories.

The approach in Math 3003 uses these factors to improve your ability to solve problems. Classroom techniques used include:

- the teacher as role model
- whole-class problem solving with teacher as control
- small-group problem solving with teacher as coach

In addition, you are assigned readings and problems that will help you identify and make progress in the four areas discussed above.

## Course Methods:
- *Use of groups:* There is almost a century of research showing that academic achievement, productivity, and self-esteem improve dramatically when students work together in groups. This method emphasizes teamwork, cooperation, and support by others rather than isolation and competition in learning.
- *Role of the classroom instructor:* There will be less direct "lecturing" in class than usual, with many questions "answered" by another question to help you work through your own questions and difficulties. You are expected to learn problem solving through active involvement - reading, writing, and explaining to others what you are thinking and doing.

This may require some adjustment in the way you think about teaching and learning. Initially, you may wish for more direct information and answers, but your patience and effort will be rewarded with a deeper understanding and increasing independence in problem solving, as well as confidence in your ability to tackle new problems.

## Comments on the Written Homework:
1. This is the minimum amount of homework that is required but you may need to do several odd numbered problems to make sure you get the answer in the textbook.

2.  A homework assignment is late if it is not received at the start of class on the due date.  No late homework will be accepted except by prior arrangement or with a documented emergency.
3.  Please be sure that your homework is stapled together and the problems are in order.
4.  Homework will be scored on a combination of completeness and correctness. All work necessary to complete a problem must be shown to earn credit.
5.  Start working on your homework early. These problems are difficult and meant to be done a little at a time over the course of a few days.
6.  When doing homework, please note it is normal to not be able to do every problem correct on the first attempt. Do not be discouraged, instead seek help.

## References:

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**Class Schedule:** This course syllabus and schedule are subject to change due to unforeseen circumstances.

| Week of | Tuesday (Lab Day) | Thursday (Lectures) | What Is Due Soon |
|---|---|---|---|
| 1/9/2022 | *NO LAB*<br><br>*Week 1* | **Lecture:** Course Intro & Ch.1<br><br>Intro to Voting Systems | Obtain Course Materials<br><br>Register MyLab, IntroOA |
| 1/16/2022 | Open Lab (Zoom) | **Lecture:** Chapter 1<br><br>Alternative Voting Systems | OA1.1-1.6<br><br>Quiz 1, HW1 |
| 1/23/2022 | Open Lab (Zoom) | **Lecture:** Chapter 2<br><br>Weighted Voting Systems | OA2.1-2.2 |
| 1/30/2022 | Open Lab (Zoom) | **Lecture:** Chapter 2<br><br>The Power Distributions | OA2.3-2.4<br><br>Quiz 2, HW2 |
| 2/6/2022 | Open Lab (Zoom) | **Lecture:** Chapter 4<br><br>Apportionment and Hamilton's | OA4.1-4.3 |
| 2/13/2022 | Open Lab (Zoom)<br>Review for Exam | **Lecture:** Chapter 4<br><br>More Apportionment Methods | OA4.4-4.5<br><br>Quiz 4, HW4, Study |
| 2/20/2022 | **Exam #1** | **Lecture:** Chapter 5<br><br>Intro to Graph Theory | OA5.1-5.2<br><br>*Group Project* |
| 2/27/2022 | Open Lab (Zoom) | **Lecture:** Chapter 5 & 6<br><br>Street Routing Problems | OA5.3-5.4<br><br>Quiz 5, HW5 |
| 3/6/2022 | *Spring Break* | | |
| 3/13/2022 | Open Lab (Zoom) | **Lecture:** Chapter 6<br><br>Traveling Salesman Problems | OA6.1-6.2,6.4 |
| 3/20/2022 | Open Lab (Zoom) | **Lecture:** Chapter 6 & 7<br><br>Network Problems and Trees | OA6.3,6.5,7.1,7.2<br><br>Quiz 6, HW6 |
| 3/27/2022 | Open Lab (Zoom)<br>Review for Exam | **Lecture:** Chapter 7 & 10<br><br>Kruskal's and Interest | OA7.3,10.1-10.2<br><br>Quiz 7, HW7 |
| 4/3/2022 | **Exam #2** | *Easter Break* | |
| 4/10/2022 | *NO LAB*<br><br>*Easter Break* | **Lecture:** Chapter 10<br><br>Finance and Amortization | OA10.3-10.5<br><br>Quiz 10, HW10 |
| 4/17/2022 | Open Lab (Zoom) | **Lecture:** Chapter 8<br><br>Task-Processor Problems | OA8.1-8.3<br><br>*Budget Project* |
| 4/24/2022 | Open Lab (Zoom) | **Lecture:** Chapter 8<br><br>The Critical Path Algorithm | OA8.4-8.5<br><br>Quiz 8, HW8 |
| 5/1/2022 | *NO LAB*<br><br>*Finals Week* | **Final Exam: Friday, May 5<sup>th</sup>**<br>4:30-7:00pm for all sections | |