MAT 513 ANALYSIS FOR TEACHERS

SPRING 2021

Instructor: Lisa Berger
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Web page: `http://www.math.sunysb.edu/~lbrgr/`
Current Office Hours:

Mondays: 3-4 Online
Tuesdays: 5-6 Online
Wednesdays: 6-7 Online
By appointment.
`http://www.math.stonybrook.edu/office-hours`

Office hours may be adjusted to accommodate the instructor's schedule and/or student needs. Students unable to meet during scheduled office hours are encouraged to schedule an appointment with the instructor.

Semester Schedule. This course will run on-line, synchronously, Monday/Wednesday 4:25pm - 5:45pm.

Technology Requirements. Access to a computer and a stable internet connection is required. Access to a scanner, which may be a simple app on a smartphone is required. Access to a webcam for proctored quizzes and exams is required.

General Information. This is a course in real analysis. A primary goal is for you to improve your depth of understanding of functions and calculus while learning how ideas from this course are embedded in the secondary curriculum. We will discuss high school level pre-calculus and calculus topics as we simultaneously study these topics from a more advanced level and with a significant increase in rigor. This course may include both new and familiar topics; your objective should be to increase your *depth* of understanding of each topic studied. This course will emphasizes understanding definitions, mathematical proof, and mathematical writing. You should be prepared to work through a lot of problems, prove your results and write your work clearly and accurately.

Pre-requisites. A *minimum* pre-requisite for this course is completion of MAT 511. A strong background in undergraduate mathematics, including college calculus, is also assumed, and an undergraduate course in analysis is helpful.

Textbook. We will be using the second edition of the book *Understanding Analysis*, by Stephen Abbott. As the semester progresses, you may also want to refer to a high school or college calculus textbook. You should already have one; if not, I would suggest borrowing one from the Stony Brook library, a public library, or your high school campus.

Homework/Class Work/Quizzes.

Homework is an essential component of the course. Homework will be assigned and collected regularly, and selected problems will be graded. Homework is due at the beginning of the class period, and late homework will not be accepted. Information for electronic submission of homework will be provided, and each submission should be a single pdf file. Announced and/or unannounced quizzes may be given, and there may be assignments completed and submitted during class. Students are expected to be present for class, and missed quizzes or classwork may not be completed for credit. The lowest 2 scores in the homework/classwork/quiz category will be dropped.

A significant part of doing mathematics is *communicating* mathematics. Homework is expected to be clear and grammatically correct, in addition to mathematically accurate. Homework not meeting this criteria may be returned ungraded.

You are encouraged to work together, but submitted written assignments must be your own work and represent your own understanding. You should not search for, read, or submit any solutions or partial solutions obtained from the internet. If you need clarification on this policy, please ask.

Exams.

There will be two midterms exams and a final exam. Exam 1 is *tentatively* scheduled for Wednesday, March 10. Exam 2 is *tentatively* scheduled for Monday, April 12. The **final exam** is scheduled by the University for Tuesday, May 18 from 2:15 pm to 5:00 pm. Because some students may be teaching in 7-12 schools, **there will be a take-home component of the exam due on Tuesday, May** 18**, and the in-class exam will run from 3:30 pm to 5:00 pm. on Tuesday, May** 18**.**

Final Grades. Your final grades will be based on the following:

(1) Exam 1: 20%
(2) Exam 2: 20%
(3) Homework/Quizzes/Classwork: 30%
(4) Final Exam: 30%

An Abundance of Caution. I did not expect virtual snow days, but it seems they exist. In the event that the University cancels additional classes, we will make an effort to keep up with the syllabus. Possible options may include, for example, a short reading assignment or a short problem set to be completed before the next class. Please check email and the course web page if a class is cancelled. Please make sure you are receiving Stony Brook Alerts.

Academic Integrity.

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website at: `http://www.stonybrook.edu/commcms/academic_integrity/index.html`

Submitting solutions obtained from the internet is submitting someone else's work as your own; to do so is a violation of the policy on academic integrity.

If you do not understand the policy on academic integrity, please ask for clarification.

Student Accessibility Support Center Statement: If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Student Accessibility Support Center, Stony Brook Union Suite 107, (631) 632-6748, or at sasc@stonybrook.edu. They will determine with you what accommodations, If any, are necessary and appropriate. All information and documentation is confidential.

`https://www.stonybrook.edu/commcms/studentaffairs/sasc/current_students/accommodation.php`

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Student Accessibility Support Center. For procedures and information go to the following website:

`http://www.stonybrook.edu/ehs/fire/disabilities`

Critical Incident Management. Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of University Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.

Student Absences Statement. Students are expected to attend every class, report for examinations and submit major graded coursework as scheduled. If a student is unable to attend lecture(s), report for any exams or complete major graded coursework as scheduled due to extenuating circumstances, the student must contact the instructor as soon as possible. Students may be requested to provide documentation to support their absence and/or may be referred to the Student Support Team for assistance. Students will be provided reasonable accommodations for missed exams, assignments or projects due to significant illness, tragedy or other personal emergencies. In the instance of missed lectures or labs, the student is responsible to seek notes from a classmate and stay on-track with required reading and assignments. Please note, all students must follow Stony Brook, local, state and Centers for Disease Control and Prevention (CDC) guidelines to reduce the risk of transmission of COVID. For questions or more information click here: `https://www.stonybrook.edu/commcms/comingback/students.php`.

Learning Outcomes.

- Students state and use the well-ordering property of the natural numbers and use the principal of mathematical induction to prove a statement is true for all natural numbers.
- Students understand and use the field axioms and order axioms of the real numbers and understand the relevance of these axioms to the secondary curriculum.
- Students understand and use the completeness axiom and the Archimedean property of the real numbers. Students identify supremum and infimum of sets of real numbers.
- Students explain basic topology of the real numbers, e.g., open, closed, bounded, compact.
- Students state and use the Bolzano-Weierstrass theorem.
- Students clearly state and use properties of a metric space.
- Students can prove convergence and divergence of sequences of real numbers and can discuss examples relevant to the secondary curriculum.
- Students can identify Cauchy sequences and prove that a convergent sequence is Cauchy. Students know and use the Cauchy Convergence Criterion for sequences of real numbers and can discuss examples of Cauchy sequences in the secondary curriculum.
- Students can state a clear, concise definition of the limit of a function at a point and can prove that a function converges or diverges at a point. Students can discuss examples relevant to the secondary curriculum.

- Students can state a clear, concise definition of continuity of a function at a point and can prove that a function is continuous or discontinuous at a point. Students can discuss examples relevant to the secondary curriculum.
- Students use the Intermediate Value Theorem and discuss appropriate ways to teach this theorem to high school students.
- Students can determine whether or not a function is uniformly continuous and prove their result.
- Students understand and use the definition of the derivative of a function at a point and prove and use standard methods of differentiation, e.g. product rule.
- Students use the Mean Value Theorem and discuss appropriate ways to teach this theorem to high school students. Students use and understand the inverse function theorem.
- Students determine the limit of a function at infinity and understand and use L'Hopital's Rule.
- Students use Taylor's theorem for approximating functions.
- Students use the definition of the Riemann integral to determine when a real-valued function is integrable and, if so, to determine the value of the definite integral.
- Students know and use various properties of the Riemann integral, including the triangle inequality for integrals.
- Students know and use the Fundamental Theorems of Calculus.
- Students evaluate improper integrals and discuss examples relevant to secondary students.
- Students prove convergence and divergence of series, with particular attention to series studied in the secondary curriculum.