Real Analysis I (MAT 425)

Meeting Times: MWF 12:00-12:50pm
Meeting Location: Neville Hall 206
Instructor: Casey Pinckney (casey.pinckney@maine.edu)
Credits: 3
Prerequisites: A grade of C or higher in both MAT 228 and MAT 261

Real Analysis is a study of functions of a real variable and the related topology of the real line. This course is foundational to the study of mathematics in standard upper-level mathematics coursework at the undergraduate level. We will study the concepts of limit, convergence, continuity and differentiability with a much more rigorous approach than seen in calculus courses, and see many new concepts and results arise as well. The course places an emphasis on theory and proofs with mathematical rigor.

Among the outcome goals of this course are:

- Precisely state major definitions and theorems concerning real numbers, as well as their negations, contrapositives, etc. (e.g., define uniform continuity of a function).

- Demonstrate an understanding of definitions and theorems from real analysis through their direct application (e.g., is the set $\{x \in \mathbb{R} \mid \sin(x) = 0\}$ open? closed? compact? What is its cardinality?).

- Interpret and communicate important concepts and results from real analysis in a clear and concise way (e.g., describe the real line as a complete, ordered field).

- Apply theory to demonstrate an understanding and analytical skills (e.g., prove $x^3 - 3x + b = 0$ has at most one root in the interval $[-1,1]$ for any $b \in \mathbb{R}$ using the Mean Value Theorem).

- Evaluate the soundness of an argument and, if it has errors, determine how they could be corrected (e.g., given the following proof of the proposition that all positive real numbers have square roots, mark any incorrect steps or steps that are missing and correct them/fill in the gaps...).

- Create mathematically rigorous proofs by drawing from an array of techniques (proof by contradiction, proof by induction, proof by construction, epsilon-delta proofs, etc.) and combining a number of results from the course as needed (e.g., prove that a Cauchy sequence of real numbers is bounded).

If you are interested in previewing more content for the course, feel free to check out Stephen Abbott's *Understanding Analysis*, an electronic version which is freely available to students through SpringerLink.

Those wishing to continue on to study more real analysis will likely be interested taking in MAT 426 (Real Analysis II) after successfully completing MAT 425.