University of Maine – Department of Mathematics & Statistics
MAT 524 – Real Analysis II
Spring 2025

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Lecture: MWF 10:00-10:50pm in Neville Hall 421

Credits: 3

Prerequisites: MAT 523

This is a continuation of Real Analysis I, where we constructed Lebesgue measure and the Lebesgue integral. Continuing with Royden & Fitzpatrick's *Real Analysis*, we will expand on these with

- abstract measure theory – construction of measures on spaces that aren't necessarily copies of $\mathbb{R}^n$,
- integration of complex-valued functions,
- Banach and Hilbert spaces – generalizations of vector spaces to possibly infinite dimensions,
- Fourier analysis – the conversion from the amplitude to the frequency domain,
- L^p spaces – the space of functions whose p-th power is absolutely integrable (modulo equivalence).

Some major theorems are

- the Lebesgue Differentiation Theorem & the Fundamental Theorem of Calculus for the Lebesgue Integral – shows that integration and differentiation are inverse operations (now under very precise hypotheses),
- the Riesz Representation Theorem – shows that every bounded linear function from an L^p space to $\mathbb{C}$ is given by integration,
- the Fourier Inversion Theorem – answers the question of when the inverse Fourier transform is equal to the original function,
- the Fubini and Tonelli Theorems – answers the question of when we may safely interchange integrals.