Mathematics & Mathematics Education Seminar

28 SEPTEMBER 2026
(MONDAY)
10.30 to 10.50 am
MATH JOURNAL ROOM
NIE7-03-16

Gauging Randomness: A Full-Division Construction of the Backwards McShane—Itô Integral

The Henstock-Kurzweil integral arises from a single, deceptively small change to the Riemann integral: the constant mesh size is replaced by a variable *gauge* function $\delta(\cdot)$. This idea yields an integral more powerful than Lebesgue's, yet still built entirely from tagged Riemann sums. In this talk we follow that idea as it is loosened by McShane, reversed in time to give a *backwards* integral, and finally carried into stochastic analysis: the integration of operator-valued random processes against a Hilbert-space-valued Q-Wiener process, defined constructively through Riemann-type sums.

Existing generalized-Riemann constructions of such stochastic integrals rely on *partial* divisions, which cover the time interval only up to a set of small measure; the resulting gaps complicate the analysis. We present recent joint work developing the backwards McShane—Itô integral on a *full-division* framework, which covers the whole interval and removes these obstructions — yielding direct proofs of Henstock's Lemma and the AC^2-property of the primitive, an Itô isometry, the backwards L^2-martingale property of the primitive, and equivalence with the existing backwards Itô-Henstock integral. Building on these, we establish a family of convergence theorems for the integral, culminating in an *equiintegrability convergence theorem*: a single gauge acting uniformly across the sequence yields convergence with *no dominating function at all* — a mode of convergence unavailable to the Lebesgue-based theory, and the capability for which the gauge approach was created.

The talk is intended to be accessible to graduate students; familiarity with the Riemann integral suffices, and no measure theory is assumed.

Joint work with Abdul Aziz, Ch. Rini Indrati, and Nanang Susyanto (Universitas Gadjah Mada).

Jayrold P. Arcede
Professor of Mathematics, Caraga State University, Philippines

Speaker's Biography

Jayrold P. Arcede is Professor of Mathematics at Caraga State University, Butuan City, Philippines, where he is affiliated with the Mathematical and Statistical Computing and Research Center. His research spans stochastic integration via the generalized Riemann (Henstock–Kurzweil) approach, mathematical epidemiology, and physics-informed machine learning for geohazard modelling. His work in gauge integration connects to the Henstock tradition through his collaboration on the backwards and Itô–Henstock integrals for operator-valued stochastic processes. He leads several DOST-funded research programs on earthquake- and rainfall-induced hazards in Mindanao, and maintains active international collaborations with institutions in Indonesia, France, Norway, Thailand, and Brazil. He supervises graduate students in mathematics and applied mathematics, and has helped organize regional mathematics schools including SEAMS and CIMPA schools in the Philippines.

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