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Stochastic integration and differential equations—a new approach, by Philip Protter. Springer-Verlag, Berlin and New York, 1990, 302 pp., $48.00. ISBN-0-387-50996-8

Stochastic integration and stochastic differential equations are important for a wide variety of applications in the physical, biological, and social sciences. In particular, the last decade has seen an explosion in applications to financial economics. The need for a theory of *stochastic* integration is readily seen by considering integrals of the form $\int_{[0,t]} X_s\, dM_s$ and noting that these can be defined path-by-path in a Stieltjes sense for all continuous integrands X only if the paths of M are locally of finite variation. This immediately precludes such important processes as Brownian motion and all continuous martingales as integrators, as well as many discontinuous martingales. Consequently, for a large class of martingales M, one must resort to a truly probabilistic or stochastic definition of such integrals. The origins of the theory of stochastic integration lie in the early work of Wiener and the seminal work of Itô [11], where integrals with respect to Brownian motion were defined. Most importantly for applications, Itô developed a change of variables formula for C^2 functions of Brownian motion. In presenting the results of Itô in his book [7], Doob recognized that the two critical properties of Brownian motion B used in Itô's development of the stochastic integral were that B and $\{B_t^2 - t, t \geq 0\}$ are martingales. Extrapolating from this, Doob proposed a general integral with respect to L^2-martingales, which hinged on an as yet unproved decomposition theorem for the square of an L^2-martingale. This is a special case of a decomposition theorem for submartingales (the Doob-Meyer decomposition theorem), which was subsequently proved by Meyer [17, 18]. Using this decomposition result, Kunita and Watanabe