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The mathematical backups in the option pricing theory

Option pricing theory developed by Black and Sholes depends on an arbitrage opportunity argument. An investor can exactly replicate the returns to any option on that stock by continuously adjusting a portfolio consisting of a stock and a riskless bond. The value of the option equal the value of the replicating portfolio. However, transactions costs invalidate the Black-Sholes arbitrage argument for option pricing, since continuous revision implies infinite trading. Discrete revision using Black-Sholes deltas generates errors which are correlated with the market, and do not approach zero with more frequent revision when transactions costs are included. Stochastic calculus serves as a fundamental tool in the mathematical finance. We closely look at the utility maximization theory which is one of the main option valuation methods. We also see that how the stochastic optimal control problems and their solution methods are applied to the theory.