Bridging Financial and Physical Modeling: A New Fundamental Link Between CIR and ROU Frameworks

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In the world of financial and physical modeling, two popular frameworks are often used to describe how systems return to "normal" after a disturbance. The Cox–Ingersoll–Ross (CIR) model is widely used to model quantities that can never drop below zero, such as interest rates or population sizes. The Reflected Ornstein–Uhlenbeck (ROU) model describes systems that naturally bounce back from a fixed boundary, much like a spring hitting a wall. While these two models have traditionally been viewed as distinct tools, this research establishes a new fundamental link between them. We demonstrate that as specific parameters within the CIR model are adjusted, the model "transforms" and eventually becomes indistinguishable from the ROU model, which is significantly easier to implement and offers intuitive "spring-like" physics that enable faster simulations and clearer analytical results