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# Stochastic Modeling of COVID-19 Dynamics with Emphasis on Asymptomatic and Isolated Populations

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## Abstract

This study delves into the intricate dynamics of the COVID-19 epidemic by extending a deterministic compartmental model incorporating asymptomatic, quarantined and isolated compartments, with a stochastic model capturing the natural randomness of the processes. Traditional analytical methods face challenges in capturing the complexities arising from the dynamic interactions between these compartments. Our primary goal is to unravel the long-term behavior and stability of the COVID-19 epidemic model using this innovative stochastic framework. In this work, we establish stochastic threshold conditions that govern disease extinction and persistence while exploring the characteristics of a stationary distribution. The derived insights, anchored in rigorous theoretical underpinnings, are further substantiated through an exhaustive numerical analysis. Crucially, the parameters of our model are meticulously calibrated against empirical data pertaining to the COVID-19 outbreak in India. By bridging theory and practical applications, we showcase the significance of stochastic modeling in comprehending the intricate nature of epidemic dynamics, specifically within the context of COVID-19.

**Key words:** Stochastic Epidemic Modeling, COVID-19 Pandemic, Population Dynamics, Asymptomatic and Isolated Cases, Real data, Persistence and Extinction Dynamics [1].

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## References

- [1] T. Caraballo, I. Bouzalmat, A. Settati, A. Lahrouz, A. N. Brahim, and B. Harchaoui, Stochastic COVID-19 epidemic model incorporating asymptomatic and isolated compartments, . *Math. Meth. Appl. Sci.* (2024), 1–23, DOI 10.1002/mma.