



# ***Mathematical Biology Seminar***

**Monday, October 3, 2022**

**3 pm MDT (Virtual)**

**Join Zoom Meeting**

<https://ualberta-ca.zoom.us/j/98497695684?pwd=SG5pcUVR50xucW5xd0xBTm1VVcUUT09>

Meeting ID: 984 9769 5684

Passcode: 32123



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## **The Dictator Equation**

Humans have been discussing the benefits and drawbacks of democratic vs. authoritarian governance for millennia, with perhaps the earliest and most famous discussion favoring enlightened authoritarian rule contained in Plato's 'Republic'. The commonly cited benefits of an enlightened dictatorial regime are the efficiency of governance and long-term horizon in planning due to the independence of frequent election cycles. To analyze the claims of potential superiority of an authoritarian rule, we develop a simple mathematical theory of a dictatorship in the ideal case of a dictator wanting the best outcome for the country, with the additional external noise describing external and internal challenges in the country's path.

We assume the linear proportional feedback control based on the information provided by the output from the advisors. The resulting stochastic differential equations (SDEs) describe the evolution of both the trajectory of a country's well-being and the accuracy of advisors' information. We show the system's inherent instability due to the corruption of the advisor's information provided to the dictator. While the system without noise does possess a large amount of phase space with stable solutions, the noise pushes all solutions to the unstable regime. We show that there is a typical unstable time scale that is described by a single dimensionless constant and describe the long-term evolution of the system using asymptotic solutions, some results from the theory of SDEs and phase space analysis. We also discuss the potential application to real-life data.

No previous knowledge of Ito's calculus or theory of SDEs is assumed; all necessary results from that theory will be given during the lecture.

***COLLABORATIVE MATHEMATICAL BIOLOGY GROUP***

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