

COLLOQUIUM

4-11-24

Neckers 156 Time: 3:00pm

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Graduate Students “Double-Header” Colloquium

Speakers: **Taniya Chandrasena**, SIUC

Title: **Stochastic SEIR(S) Model with Random Total Population**

Date: **4-11-2024**

Time: **3:00-3:25 pm**

Place: **Neckers 156**

Abstract: The stochastic SEIR(S) model with random total population and random transitions is given by the system of stochastic differential equations:

$$dS = (-\beta SI + \mu(K-S) + \alpha I + \zeta R)dt - \sigma_1 S I F_1(S, E, I, R)dW_1 + \sigma_4 R F_4(S, E, I, R)dW_4 + \sigma_5 S(K-N)dW_5$$

$$dE = (\beta SI - (\mu + \eta)E)dt + \sigma_1 S I F_1(S, E, I, R)dW_1 - \sigma_2 E F_2(S, E, I, R)dW_2 + \sigma_5 E(K-N)dW_5$$

$$dI = (\eta E - (\alpha + \gamma + \mu)I)dt + \sigma_2 E F_2(S, E, I, R)dW_2 - \sigma_3 I F_3(S, E, I, R)dW_3 + \sigma_5 I(K-N)dW_5$$

$$dR = (\gamma I - (\mu + \zeta)R)dt + \sigma_3 I F_3(S, E, I, R)dW_3 - \sigma_4 R F_4(S, E, I, R)dW_4 + \sigma_5 R(K-N)dW_5,$$

where $\sigma_i > 0$ and constants $\alpha, \beta, \eta, \gamma, \zeta, \mu \geq 0$. $K > 0$ represents the maximum carrying capacity of total population N .

The SDE for the total population $N = S + E + I + R$ has the form

$$dN(t) = \mu(K-N)dt + \sigma_5 N(K-N)dW_5$$

on $D_0 = (0, K)$. The goal of our study is to prove the existence of unique, Markovian, continuous time solutions on the 5D prism

$$D = \{ (S, E, I, R, N) \in \mathbb{R}_+^5 : 0 \leq S, E, I, R \leq K, N = S + E + I + R \leq K \}.$$

Then, using the method of Lyapunov functions, we prove the asymptotic stochastic and moment stability of disease-free and endemic equilibria. Finally, we use numerical simulations to illustrate our results. This is based on the joint work with Prof. Henri Schurz, which was submitted for publication.

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Speakers: **Mohammed Mousa A M Alshamrani**, SIUC

Title: **Simple Smale Flows with a Three-Band Template**

Date: **4-11-2024**

Time: **3:30-3:55 pm**

Place: **Neckers 156**

Abstract: A Smale flow is a structurally stable flow with one-dimensional invariant sets. We study Smale flow with chain recurrent sets consisting of an attracting closed orbit, a repelling closed orbit, and a saddle set that is a suspension of a full 3-shift. We use tools from template theory to construct and visualize nonsingular Smale flows in the 3-sphere.