# Abstracts. April 22, 2023 (see both sides)

Opening Address

**Permutation Entropy in Time Series**

*Dr. Megan Martinez, Ithaca College*

A time series is a set of data indexed by time; for example, they are used in finance, weather forecasting, and earthquake prediction. Appropriate analysis of time series allows us to understand the nature of a system. To this end, one tool that has been developed for analysis is permutation entropy, which examines the relative ordering of consecutive data points in a time series. But what exactly does this entropy measure? What would permutation entropy look like in a more deterministic time series? What about a random one? In this talk, we will work to understand permutation entropy, and how it behaves with different kinds of time series.

Closing Address

**When Mathematics Says No: The Aesthetics of Impossibility**

*Dr. Susan Goldstine, St. Marys College of Maryland*

Sometimes, when we pose questions of mathematics, its answers are strikingly contrary. Why cant we trisect an angle with the same tools we use to bisect an angle? Its not possible. Why havent we found the quintic formula? It doesnt exist. Can we at least prove that arithmetic is logically consistent? Nope! We can view these results as intransigent obstacles to human knowledge, or we can accept them as fascinating illustrations of the boundaries of different mathematical techniques. In this talk, we will explore analogous results for techniques in the fiber arts. For each form of knitting, crochet, embroidery, and so forth, there is a set of limitations on what types of designs they can produce. Sometimes, these limits are broad enough that the art form can encompass every mathematical possibility. Other times, the craft imposes intriguing restrictions on what patterns we can produce, and we will make the case that these restrictions have their own intrinsic beauty.

Student Presentations (in alphabetic order of last names)

**Knot corner-mosaics and tile numbers**

*Ezra Aylaian, University of Maryland, College Park*

A knot mosaic is a grid of pictorial tiles representing a tame knot or link. Eric Rawdon, Elizabeth Paterson, and Sayde Jude recently introduced what we call knot corner-mosaics, a different set of tiles that also represent a tame knot or link. We define the (corner) tile number, the minimum number of tiles needed to represent a knot as a (corner) mosaic. Our main result is a correspondence between mosaics and a certain kind of corner-mosaics, which has exciting implications for the tile number.

**Invariant groups with a positive action-genus**

*Megan Doring, Towson University*

The genus of a graph $\Gamma$ is the minimal genus of all surfaces on which $\Gamma$ can be cellularly embedded. We define the action-genus of a finite group $G$ to be the minimal genus of all graphs $\Gamma$ such that the automorphism group of $\Gamma$ is isomorphic to $G$. I have investigated the action-genus for finite families of groups, including quasidihedral groups and quasiabelian groups.

**Biological Micro Locomotion**

*William Hunter, Towson University*

The movement of biological micro-organisms within a fluid follows vastly different mathematical and physical laws than are present for macro-organisms. Because of their small size, the effect of inertia on micro-organisms is negligible; this forces these organisms to use different means of locomotion and swimming and is termed swimming at low-Reynolds number. Preliminary investigations have allowed mathematicians to model some forms of micro-organism swimming in such a state, as the topic has numerous applications in the field of medicine, both for delivery and disposal. The use of artificial micro swimmers using locomotion methods similar to micro-organisms to deliver medicine to targeted parts of the body is one such application.

**Using Optimal Transport Theory to Optimize Decision Making on How Sleep Quality and Activity Influence the Outcome of Pregnancy**

*Kim Ngan (Luna) Huynh, Stevenson University*

The majority of pregnant women have experienced poor sleep quality as their body changes over time. Not getting enough sleep may increase the risks of developing some common complications of pregnancy such as gestational diabetes, hypertension, preeclampsia. Physical activity may be essential that helps improve the sleep efficiency of pregnant women. The aim of this study was to determine whether sleep quality and activity were associated with the outcome of pregnancy during gestation weeks 22. The mothers sleep quality was determined by calculating the variability of activity during sleep time. The mothers moderate physical activity was determined by calculating the area of the curve of the individual activity plot. Results showed that the variability during sleep time and the area under the curve of good pregnant women was significantly difference than that of bad pregnant women at 99

**Methods of Parameter Identification and their Applications to In Vivo HIV Drug Models**

*Matthew Lastner and Mac Luu, University of Maryland, Baltimore County*

Mathematical models of disease dynamics play an important role in understanding the impact of intervention methods. We focus on an in vivo model of HIV represented by a system of ordinary differential equations and determine whether the model parameters can be uniquely identified from experimental data. This model captures the dynamics of CD4+ T-cells and virions during antiretroviral therapy (ART). We determine the identifiability of the parameters relative to the observables total CD4+T cell and virion count. Applying differential algebra, we determine whether the models parameters are structurally identifiable with respect to noiseless sample data. Monte Carlo techniques are used to determine practical identifiability, that is, if the parameters can be identified with noisy observable data. An in vivo model with identifiable parameters can be coupled to a population-level model, in which infectivity of an individual is determined by their viral load.