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**SSD2019: STUDENT SCHOLARS DAY**

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Department of Mathematical Sciences  
Appalachian State University

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## 1 North Carolina College Graduates' Salaries

- **Time of the talk:** 10:00 am — 10:30 am
- **Presenter:** James Watkins (Undergrad non Thesis)
- **Abstract of the Talk:**

In fitting multiple regression models against salaries of college graduates, the title of the presentation is Predicting Average Salaries of College Graduates by School. As potential future earning plays an unseen role in students' likelihood of pursuing to some degree, we investigate several factors that may well describe why some alumni are more successful than others. This exploration was guided by the noticeable willingness of universities to encourage students from all backgrounds and aptitudes to enter high-paying fields such as in STEM or health care. The research considered many different approaches but decided to only focus on the colleges and universities in North Carolina due to Appalachian's continued membership in the UNC System. It also believed the median to be the most appropriate form of average to study in order to generalize, rather than praise or humiliate either extremities. Our findings were to some extent expected and we included many modelling techniques for fitting our regressors. We determined the most influential factors to be whether a school was public or private, undergraduate enrollment, admission percentage, whether or not the school grants doctorates, and the average ACT score of incoming students. We were surprised to find that the logistic regression model fit the data better than any other and elected to keep as the final result.

## 2 Who Is Ready To Retire: Your Average Life Expectancy And The Savings Needed To Support You

- **Time of the talk:** 10:30 am — 11:00 am
- **Presenter:** Kaitlyn Burkett (Undergrad Thesis)
- **Abstract of the Talk:**

The following work helps predict the life expectancy of an individual and how much they will need to save each month in order to live to that age after retirement. People often forget about life after retirement until its too late to start saving properly. This project is hoping to bring this idea to people's attention earlier and to make the process easier. The work presented first finds a model to predict that life expectancy and then the creation of a calculator to give the minimum monthly contribution to savings needed to live comfortably in retirement.

### 3 Symmetry in Atonal Music

- **Time of the talk:** 11:00 am — 11:30 am
- **Presenter:** Sergei Miles (Undergrad Thesis)
- **Abstract of the Talk:**

Atonal music is composed by re-playing permutations of a given twelve-tone row. By including complete re-orderings of a twelve-tone row the composer guarantees that each of the twelve pitch-classes repeat equally in a composition. These permutations are reached via row operations to maintain the desired symmetry of the original twelve-tone row; however, the final musical piece may not only use these particular re-orderings exclusively. The composer then gives no preference to a particular subset of notes and avoids key-structure in the music, which is a significant part of the structure in traditional tonal music. We investigated these symmetries in twelve-tone rows and then worked to apply these ideas to  $n$ -tone rows for microtonal systems. In terms of algebra, the goal is to count these unique groupings of permutations, or orbits, which can be reached via combinations of the four possible operations that preserve symmetry.

### 4 Observations of Snow Particle Characteristics during the 9-10 December 2018 Major Snowstorm in the Southern Appalachian Mountains

- **Time of the talk:** 11:30 am — 12:00
- **Presenter:** Hannah Bush (Undergrad Thesis)
- **Abstract of the Talk:**

Although major snowstorms result in substantial societal and economic impact across the southern Appalachian Mountains, numerous critical parameters (e.g., lower tropospheric thermal structure, snow crystal type and degree of riming, quantitative precipitation forecast) are frequently not well characterized in numerical weather prediction models. This study analyzes the meteorological characteristics of the 9-10 December 2018 major winter storm using data from a Multi-Angle Snowflake Camera (MASC), a vertically pointing Micro Rain Radar (MRR), the ERA-Interim dataset, NOAA's Rapid Update Cycle (RUC) soundings, and other in-situ measurements. In particular, the MASC data allowed for classification of snow crystal types, complexities, and degree of riming throughout the entire storm. There is a clear correlation in the complexity and roughness of the ice crystals as the storm progressed in time. This correlation aligns with different weather variables that were collected on the surface as well as aloft. This study enhances an understanding of the process and components of the winter storm along with an improved understanding of the differences among snowfall events.

## 5 A Brief Survey of Manifolds and Vector Bundles

- **Time of the talk:** 12:00 — 12:30 pm
- **Presenter:** Will Dulaney (Undergrad Thesis)
- **Abstract of the Talk:**

In this talk, we consider several ideas from manifold theory. First, we explore the definition of a manifold and consider a few examples. Second, we will develop the notion of the dual to a vector space followed by a look at tangent and cotangent structures on a manifold. The highlight of our discussion will be the construction of both tangent and cotangent bundles and their generalization to vector bundles as well as a brief introduction to sections of these bundles.

## 6 Modeling Saturn's Rings

- **Time of the talk:** 02:00 pm — 02:30 pm
- **Presenter:** Patrick Daye (Graduate Research Talk)
- **Abstract of the Talk:**

The particles that make up planetary ring systems range between a variety of different sizes and thus are affected by several forces both impacting formation as well as orbit. This project investigates a simplified approach to modeling the ring system of Saturn via solving the three-body problem with the use of the Runge-Kutta method.

## 7 Microtonal Chord Progressions and Actions of Dihedral Groups

- **Time of the talk:** 02:30 pm — 03:00 pm
- **Presenter:** Leah Hurt (Graduate Research Talk)
- **Abstract of the Talk:**

This talk focuses on applying properties of chord structure found in traditional 12-note music to systems with a generalized number of microtones  $N$ . Using equal-tempered tuning and the  $F$  to  $F\#$  property, we discover various systems having intervals whose error from the just intonation ratios are smaller than the errors in the traditional 12-note system. We look at the keyboards and tonnetz of a few representative systems. Finally, we discuss two different groups, both isomorphic to the dihedral group of order  $2N$ , and their actions on the set of major and minor triads. We investigate properties and uses of these actions.

## 8 Analyzing App State Volleyball Through a Markov Chain

- **Time of the talk:** 03:00 pm — 03:30 pm
- **Presenter:** Charlotte Cave (Graduate Research Talk)
- **Abstract of the Talk:**

A Markov Chain is a stochastic process in which the probability of any particular future behavior, when its current state is known exactly, is not altered by its past behavior. This can be useful when trying to predict long-term behaviors in various fields. Volleyball is a complex sport that involves strategic patterns of actions for maximized probabilities of earning points. I have collected data from Appalachian State's volleyball team and created an absorbing Markov Chain to analyze what types of hits the team should be using in order to maximize their chances of scoring points against some of their rivals.

## 9 Boards, Maps, and Inversions (Oh my!)

- **Time of the talk:** 03:30 pm — 04:00 pm
- **Presenter:** Samuel Powell (Graduate Research Talk)
- **Abstract of the Talk:**

Inverse problems in mathematics are notoriously difficult to solve. In this talk we examine a function on a set of objects and their associated outputs. By understanding the function, and the structure of both the inputs and outputs we will gain some insight into how to invert the process. While a complete inversion of the function is proven impossible we still see if we can recover partial solutions. This talk will appeal to both seasoned mathematicians and puzzle enthusiasts alike due to the nature of the function and objects.